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BRAZILIAN PORTUGUESE SPEAKERS' PERCEPTION OF SELECTED VOWEL CONTRASTS OF AMERICAN ENGLISH: EFFECTS OF INCIDENTAL CONTACT

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BRAZILIAN PORTUGUESE SPEAKERS' PERCEPTION OF SELECTED VOWEL CONTRASTS OF AMERICAN ENGLISH: EFFECTS OF INCIDENTAL CONTACT

by

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Dedication

For the citizens of Bratislava

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BRAZILIAN PORTUGUESE SPEAKERS' PERCEPTION OF SELECTED VOWEL CONTRASTS OF AMERICAN ENGLISH: THE EFFECTS OF INCIDENTAL CONTACT

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The purpose of this study was to examine non-English-speaking Brazilian adults' perception of American English vowels at various levels of English contact. Specifically, it addressed two two-vowel American English contrasts, /i/-/I/ and /u/-/ʊ/, that both occupy the vowel space of one Brazilian Portuguese category, /i/ and /u/, and one two-vowel contrast, /e/-/ɛ/, that exists in both languages. For reliability purposes, the three contrasts were presented in two different orders to total six contrasts in all. Predictions, based on Flege, (1995) associated discrimination difficulties with this L1-L2 contrast pairing. However, previous discoveries of non-native speakers' sensitivity to sub-phonemic differences suggested the potential to overcome L1-related perceptual constraints (Wode, 1994).

Five groups of ten participants each [aged 20-40] contributed data [N=50]. Three Austin, Texas-resident groups participated: (group A) native American English speakers, (group B) native Brazilian Portuguese speakers with high English contact, and (group C) native Brazilian Portuguese-speakers with medium English contact. Belo Horizonte, Brazil-resident groups numbered two, including native Brazilian Portuguese speakers

with medium English contact (group D) and low English contact (group E.) Each participant took a same-different identification test in which the target vowels appeared within minimal and identical pairs.

Within-group results for medium and low contact groups associated significantly greater difficulty with the /u/-/ʊ/ contrast. Between-group results found significant differences between high and low contact groups for /u/-/ʊ/, /ʊ/-/u/, and /I/-/i/; insignificant differences between high contact and native English groups appeared for the same contrasts. These overall trends suggested a degree of flexibility for non-native perception in three of four instances as well as a significant pair-wise order effect. These overall findings should not minimize the importance of individual differences. Discussion concluded with calls for greater focus on individual differences (also reflected in Bradlow *et al.*, 1997) and greater awareness of individuals' potentials within language learning contexts.

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FIGURE 1: Two Standard American English Contrasts within the context of the Brazilian Portuguese Vowel Space (A Rough Rendering).....3

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CHAPTER 1: INTRODUCTION

1.1 A Pilot Study as a Starting Point

Out of thirty adult native Brazilian Portuguese (BP) speakers who were interviewed in a pilot study, twenty-three attested to avoiding, as much as possible, the words, "sheet" and "beach" in English-language conversations with native American English (AE) speakers. They reasoned that the embarrassment associated with mispronouncing these words outweighed the convenience of using them. Clearly, these speakers were aware of this accent feature as well as its shortcomings. Why, then, did they prefer to omit them from their vocabulary rather than learning the correct sound? Could learning to distinguish between /i/ and /I/ really prove such a difficult task? These questions led to a look into BP native speakers' production of AE, which quickly evolved into a look into their perception of AE.

Spectral analyses of word-embedded samples of /i/, a phoneme common to both languages, revealed instances of vowel reduction. Based on the above comments about 'sheet' and 'beach,' this pronunciation mistake did not prove very surprising. Far more surprising, however, was the irregularity with which both lengthening and shortening occurred: similar phonetic and *supra-segmental*[1] environments often induced very different results. The participants appeared to be guessing. When asked about their apparent guessing, they cited difficulties discriminating between /i/ and /I/. These comments shifted the investigation's focus from production to perception.

1.2 Statement of the Problem

Findings from the perception literature help to contextualize these difficulties. Best's (1995) Perceptual Assimilation Model predicts poor discrimination for a two-vowel, target-language contrast that maps onto a single, native-language vowel category. Flege's (1987, 1995) explorations into perceptual equivalence also help to characterize the perceptual difficulties of this mapping of first language (L1) vowels onto the vowel

[1] *Supra-segmental* refers to charcteristics such as intonation, pitch, and tone

inventory of the second language (L2;) he underlines the importance of *sub-phonemic perceptual abilities*[2] for overcoming these difficulties. The literature has found evidence of this sensitivity to sub-phonemic differences: Grieser & Kuhl (1989) and Kuhl (1991) present evidence for the Perceptual Magnet Effect which reflects sub-phonemic perceptual abilities in an L1; Wode (1994) points to various studies that show evidence of both L1 and L2 sub-phonemic perceptual abilities. The development of these abilities has been attributed to second language experience (as in Bohn & Flege, 1990). Both the difficulties associated with this type of L1-L2 mapping as well as learners' variable abilities to overcome these difficulties have been well documented; however, little information describes the origins of these perceptual abilities. At what point do adults begin to perceive the new sounds in a foreign language? How much *casual exposure*[3] will be sufficient for altering second language perceptual skills significantly? The following study investigates the early stages of new phonemic category formation by focusing on English exposure effects in non-English-speaking Brazilian adults. Research for the study took place in the English-speaking environment of Austin, Texas and the non-English-speaking environment of Belo Horizonte, Minas Gerais (Brazil.)

1.3 Background on Vowel Perception

The relatively large vowel inventory of AE, coupled with the non-BP sounds' similarity to some BP sounds, helps to account for BP native-speakers' perceptual confusions. A closer look at the two language systems' vowel spaces highlights this confusion more clearly in reference to two AE contrasts. According to Liljencrants and Lindblom (1972), vowels use the given language's entire vowel space to determine the boundaries of *phonemic categories*[4]. In this way, vowel phonemes tend to be maximally distant from one another (within the parameters determined by ease of articulation.) Thus, second language learners who come from an L1 with fewer vowel sounds (like BP) will

[2] Sub-phonemic perceptual abilities refer to a speaker's ability to hear sound differences that exist within a given familiar L1 phoneme.
[3] Casual exposure and incidental contact are used interchangeably in this study. They both refer to the effects of exposure that occur independently of any explicit input.
[4] Phonemic categories refer to the range of sound characteristics that make up a given sound in a given language.

contain relatively large vowel spaces. In the context of an L2 with a larger vowel inventory and subsequent smaller vowel spaces (like AE,) some single L1 categories will likely overlap with more than one L2 category. A look at Figure 3 displays this mismatch between Portuguese and English more clearly. Due to a smaller vowel inventory, the Standard Brazilian Portuguese (SBP) vowels, /i/ and /u/, both have larger vowel spaces than their Standard American English (SAE) counterparts. As a result, these two single categories of SBP overlap with two categories in SAE.

Figure 1: Two Standard American English Contrasts within the Context of the Brazilian Portuguese Vowel Space (A Rough Rendering)

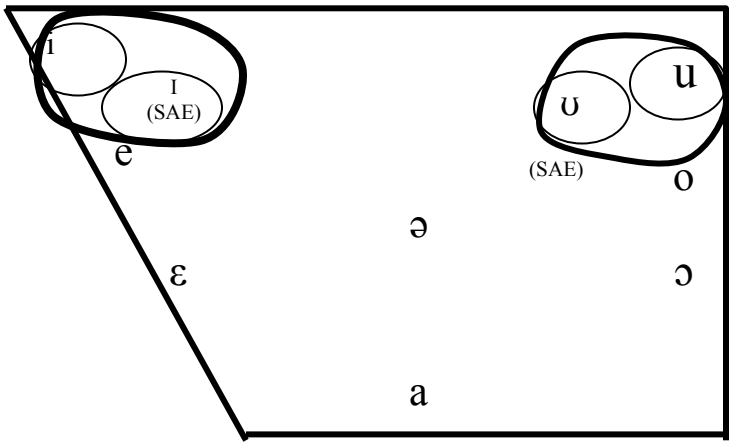


Figure 1 (above) shows the different places of articulation for the prototypical values for the two vowels in each circled contrast. The tense vowels, /i/ and /u/, are both higher than their lax counterparts, /I/ and /ʊ/. These height differences translate into different first formant frequencies for prototypical samples of the SAE phonemes. In addition, each of the two contrasts also varies in frontness, which corresponds to second formant frequencies. Despite these frequency differences, L1 influence makes distinction between them relatively difficult. In similar cases, listeners have shown a tendency to rely on the durational differences that also distinguish these phonemes from one another (Bohn and Flege, 1990).

Use of these durational differences alone, however, does not represent a reliable method for accurate perception: vowel durations can vary according to their codas (the consonant sound/sounds that follow them) and their stress patterns (in the given word and sentence) Table 1 (below) displays some of the durational differences that arise when the sounds /i/ and /I/ occur in different segmental articulatory environments. These durational differences within the context of words and phrases will receive further mention following observations related to Table 1.

Table 1: Durations of /i/ and /I/ in various articulatory environments[5]

	Word	Sound	Duration (milliseconds)
	be	/i/	276 ms
Minimal pair #1	beat	/i/	192 ms
	bit	/I/	173 ms
Minimal pair #2	bead	/i/	238 ms
	bid	/I/	199 ms

For each minimal pair, Table 1 (above) shows longer durations for /i/ tokens than /I/ tokens. A native BP speaker who relies on durational differences to discriminate between the two AE sounds, therefore, may use this distinction to aid perception. Although this relationship between the two vowels applies within each of the minimal pairs above, the actual vowel duration changes according to the given coda. This change becomes apparent with a comparison of vowels across different minimal pairs. Table 1 displays increased vowel durations for both /i/ and /I/ when the voiced coda, /d/, follows. A resulting cross-minimal pair comparison between [beat] and [bid], for example, shows much more similar values for /i/ and /I/ durations (192 ms vs. 199 ms) than for /i/ and /i/ (192 ms vs. 238 ms) or /I/ and /I/ (173 ms vs. 199ms.) All of these values appear short when compared to open /i/ (as in [be]): generally, vowels that do not contain codas have longer durations (Ladefoged, 2001). These changes to vowel duration that come out of changes to codas begin to highlight some of the irregularities that lead to perceptual

[5] These words occurred in careful speech (using a list format.) For each of the samples, measurements began with the leveling out of formant values and ended with their disappearance.

confusion. Outside of this careful, single-word, single-syllable environment, even more factors lend themselves to durational irregularity.

Further vowel length inconsistencies occur in light of suprasegmental considerations. On both the lexical and sentential levels, stress assignment affects vowel duration. Within the word, the addition of other syllables to a given vowel-coda combination often shortens vowel lengths, especially in cases in which the new syllable(s) take on the primary stress. Within the sentence, two instances of the same vowel within the same word can vary in length based on the word's placement within the sentence and its degree of emphasis. Based on these observations from both the segmental and suprasegmental realms, the same vowel can take on various lengths; some of these lengths even overlap with a contrasting vowel in a different phonetic and/or phonemic environment. Thus, reliance on durational contrast to discriminate vowel contrasts such as /i/-/I/ has the potential to create considerable perceptual difficulties for Brazilian Portuguese native speakers. In light of these numerous influences on vowel duration, non-native speakers' ability to perceive frequency differences becomes even more important. The following models of perception, however, help to underscore the difficulties associated with perceiving new vowel frequencies in an L2.

1.4 Models of L2 Perception

James Flege and Catherine Best have focused extensively on perceptual confusions that can occur in an L2. For this reason, Flege's Speech Learning Model and Best's Perceptual Assimilation Model provide the theoretical foundation for the current study. A greater understanding of each of the models, therefore, helps to describe their application to the current study and, ultimately, the issue at hand.

1.4.1 Flege's (1995) Speech Learning Model

Faithful representation of an L2 requires the formation of new, L2-specific perceptual categories. Accurately pinpointing and creating these new categories proves a more straightforward task when L2 phonemes vary greatly from L1 categories. In this

way, perceptual distance facilitates perceptual categorization; "*perceptual equivalence*"[6] impedes it. Flege's resulting model looks at the L2 learner's ability to perceive the phonological space (as described above in 1.2) between single L2 phones and pre-existent L1 categories. The mapping of specific L2 phones onto L1 categories thus plays an integral role. He emphasizes the eventual ability to produce these sounds only after accurate perceptual learning has taken place and the hearer has created phonemic categories for the new sounds.

1.4.2 Best's (1995) Perceptual Assimilation Model

Best's model focuses exclusively on perception and disregards the confounding element of production. For this reason, her model looks at phonetic equivalence in a much more relative manner: actual acoustic properties do not apply to her model. Instead, she focuses on an L2 sound's "assimilation" or lack of "assimilation" within the scheme of L1 phonemic categories. A sound that departs considerably from the L1 inventory, such as a Zulu click, is likely heard as a distinct sound that is not assimilated into any L1 category (Best, McRoberts, Sithole, 1988). However, if an L1 sound is close to an L2 sound, the listener is much more likely to assimilate it into a native category, regardless of the two sounds' actual acoustic characteristics. This "perceptual assimilation" can both aid and hinder accurate perception.

When English native speakers are exposed to Czech /i/, for example, their knowledge of the native phoneme /i/ enables them to hear the Czech variety clearly, although they likely assimilate it within the English /i/ category, which is prototypically more raised than its Czech equivalent. Although the Czech and English variations do not completely overlap with one another, the presence of /i/ in English facilitates the perception of its Czech counterpart. This proximity proves problematic, however, when a single L1 category maps onto more than one L2 category: the L2 listener will likely perceive the new categories as a single native category. Such is the case when a native English speaker comes across the Czech long /i:/; both this sound and its contrast, /i/,

[6] Perceptual equivalence refers to the perceived overlap of an L2's sound qualities with those of an L1.

likely get mapped onto the same English category, /i/. Any words that rely on the hearer distinguishing between these two sounds can easily be confused. In the case of BP native speakers who listen to AE, similar types of confusions are also quite likely if, as Best predicts, the two-vowel /i/-/I/ contrast merges with the single native category, /i/.

Best looks at pairs of L2 phones and judges their perceptibility within L1 categories regardless of their actual spectral equivalence. As with Flege's model, perceptual predictions depend upon the specifics of L1-L2 sound mapping. Also like Flege, Best believes that phonetic distance is helpful: discriminating between two sounds is easier when they are farther apart from one another. Unlike Flege, however, Best does not apply her perceptual model to production: strict perceptual adherence to native-like acoustic parameters does not serve as a prerequisite to good perception. Assimilation of the Czech /i/ sound into the English /i/ category is useful for perception purposes; however, producing sounds based on this categorization can lead to acoustic inaccuracy. Different objectives have shaped Flege's and Best's perspectives on L2 perception; they have required separate mention for this reason. In light of the current study that does not address production, however, these differences become less relevant.

1.4.3 The Two Models as They Apply to the Current Study

Despite the difference between the two perspectives, both agree that a two-category non-native vowel contrast presents perceptual difficulties for speakers' from a linguistic background that does not contain this contrast. Within the context of Flege's model, the /I/ and /ʊ/ phonemes receive the label of "similar," but not "identical." It is precisely this similarity that causes perceptual confusion: the non-native speaker mishears /I/ and /i/ as identical sounds and /ʊ/ and /u/ as identical sounds. Within the context of Best's model, the English /i/-/I/ and /u/-/ʊ/ contrasts both represent two-category contrasts, which collapse into single native vowel categories, /i/ and /u/, respectively. In this situation, Best predicts poor discrimination between the two sounds. Both of these theories, in fact, predict poor discrimination.

Also based on Flege and Best, the study assessed participants' ability to discriminate between word-embedded instances of /e/ and /ɛ/. As this contrast exists in both Portuguese and English, Best's and Flege's theories would predict relatively little difficulty perceiving it accurately. One difference between this contrast's phonemic representation in SBP and SAE relates to SBP's larger vowel space: the SBP phonemic category for /ɛ/ likely overlaps with a part of the SAE phonemic category for /æ/. This difference translates into slightly different frequency values for SBP and SAE prototypes of /ɛ/; however, Best's and Flege's theories trivialize the effects of this difference. For, similarities between the native and non-native varieties of this sound qualify it for perceptual equivalence and assimilation. Thus, the slight variations in these phonemic spaces should not be perceived by the non-English speaking participants. In this way, the /e/-/ɛ/ contrast served as a control.

This study's focus on perception as a basis for production also comes from Flege's (1981, 1987, 1991, 1992, and 1995) work. By eliminating production-related confounding factors such as muscular habit, perception analysis functions as a more reliable measurement than production analysis. Like Flege, the current study also views perceptual improvement as a means to enhancing L2 production. This relationship between perception and production will help to shape the ensuing discussion.

1.5 Need for the Study

With the preceding accounts of L2 perceptual difficulties, one might expect acquisition of similar L2 sounds to be an insurmountable task. These perceived limitations on L2 perception may discourage educators and L2 learners from attempting to improve their phonological acquisition. Indeed, Cutler (2002) characterizes "non-native listening skills" as "less flexible" than native skills (p. 3). Additionally, the oft-cited *Henry Kissenger* or *Joseph Conrad Effects*[7] (Scovel, 1988) lend themselves to accounts of L2 acquisition in which phonology stands out as the major impediment to

[7] These two effects refer to a second language learner's ability to acquire the semantic and syntactic elements of a language while failing to acquire the phonological aspects.

native-like L2 communication. A body of literature supports this perspective in reference to adult learners (Dekeyser, 2000; Long, 1990; and Patkowski, 1990; and Scovel, 1988, 2000) and two important studies even reflect this perspective in reference to pre-pubescent learners (Pallier *et al.*, 1997; Sabastián-Gallés & Soto-Faraco, 1999).

In light of the substantial research that points to instances of successful L2 sound acquisition, belief in the above perspective may cause learners and educators to underestimate their full abilities. For, much of the literature that emphasizes the difficulties associated with post-critical L2 phonological learning simultaneously allows for some rare exceptions. Flege's (1995) Speech Learning Model (SLM), for example, mentions exceptional cases in which learners can overcome the limitations of later age of L2 onset. According to his model, these learners are somehow able to reactivate their ability to perceive in a continuous way. Other studies have looked at these learners in greater detail, including those conducted by Bongaerts *et al.* (1997), Neufeld (1977, 1978, 1979), Novoa *et al.* (1988), and Schneiderman & Desmarais (1988) all point to cases in which adults have overcome age-related constraints to achieve native-like accents in their L2. Not only have these adults successfully created new L2-specific perceptual categories, but they have also retrained their neuromuscular motor skills. Thus, achieving the simpler task of perception appears more likely for a greater number of people exposed to an L2 than the "Joseph Conrad" and "less flexible" accounts at first suggest.

Achieving perceptual improvements also appears more likely in light of many learners' goals. For, although the literature often measures perception in terms of participants' degree of native-likeness, many L2 learners strive for more incremental progress towards native-like perception (Moyer, 1999). With the underlying intention of merely understanding L2 native speakers and/or being understood by them, participants may set their own criteria for target levels which deviate from native-like target levels. In this way, these participants' progress towards native-like speech may symbolize 100% accurate perception and production according to their own measures even if they do not adhere to native standards. One would expect a similarly altered approach when

exploring L2 learners that resist full integration into the L2 community (Schumann, 1978, 1986). They use accent to stand out from the native population; thus, attempts to compare their perceptual and production levels to those of native speakers are misleading. As the literature has primarily used native-like levels as its benchmark, only a small number of L2 learners have been cited as exceptions to traditional notions of age-related constraints. With the inclusion of the L2 learners who have achieved their goals of incremental progress, however, a larger number of L2 learners would become relevant to the ensuing discussion. Perhaps with this greater inclusion, a greater number of L2 learners and educators may become more optimistic about their potential to acquire an L2's phonology.

1.6 Purpose of the Study

The purpose of the study is to investigate correlations between casual exposure to English as a foreign language and ability to discriminate between selected American English vowel contrasts. Specifically, it will compare differential abilities to perceive the English contrasts, /e/-/ɛ/, /i/-/I/, and /u/-/ʊ/, among Brazilian Portuguese native speakers with high, medium, and low levels of English contact. These comparisons explored differences both within and between the three groups. The current study will depart from traditional perception studies in its criteria for participant selection and measurements of perceptual improvement. In an effort to isolate exposure's effects from other potentially influential effects of L2 knowledge, participants will qualify for the study only if they demonstrate low levels of English proficiency.[8] In order to focus on perceptual improvements instead of adherence to native standards, results from the low contact group will serve as the primary benchmark for non-native perception of English without exposure effects. The study will employ a quantitative approach to explore this issue, and quantitative results will guide the discussion of the study's findings.

1.7 Significance of the Study

[8] The criteria for "low" levels of English proficiency appear in section 3.3.1

The current study's focus adds to the literature that focuses on experience, adult L2 perceptual abilities, and adult L2 abilities in general. This theoretical knowledge will help to inform pedagogical applications. Approaches that depart from explicit classroom or laboratory training receive relatively little mention in the current literature. Nevertheless, they prove highly influential in some important literature. The current study's findings will help to extend this discussion to the perceptual realm.

Among perceptual studies, Best and Flege point to the difficulties involved with identifying an L2 contrast that maps onto a single L1 category. Cutler, Scovel, Patkowski, DeKeyser, and Long claim that adults cannot overcome these difficulties; however, Wode, Flege, Bongaerts *et al.*, Novoa *et al.*, and Schneiderman & Desmarais provide evidence to the contrary.[9] The following study will provide further information about L2 perceptual flexibility.

In terms of adults' ability to acquire an L2, the debate continues forty years after Lenneberg's initial account of the critical period. Major relevant studies have traditionally compared monolingual native speakers' production and/or perceptual abilities to those of bilingual language learners; resulting numbers of native-like L2 learners have varied substantially. The current study's approach departs from these traditional investigations by setting up both native vs. non-native and non-native vs. non-native group comparisons. With these comparisons, the study examines significant improvements to perceptual abilities that may or may not adhere to L2 native standards. Any significant improvements would be aided by sub-phonemic perceptual abilities, which would imply that Brazilian Portuguese native speakers who have very limited American English linguistic knowledge can already overcome some perceived age constraints. In this way, the current study will add to the second language acquisition literature.

[9] See the previous references to these names for the dates of their papers.

Extensions of these research areas will help to inform the foreign language education classroom. Specifically, the study will help to identify the vowel contrast combinations that L2 listeners can begin to hear without any explicit training. Suggestions for greater explicit training in the classroom will accompany the vowel contrast combinations that do not change through increased casual exposure. As a document that addresses adults' L2 perceptual abilities, the current study will help to provide L2 educators and learners with more information about their potentials before they even begin language study.

CHAPTER 2: REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter summarizes the relevant literature from three areas of research. As the current study focuses on adults' attempts at perceiving non-native vowel contrasts, the first topic addresses second language learners' potential for perceiving new sounds in a second language. The second area of review helps to contextualize the current study's focus on learning by summarizing literature that deals with second language perceptual learning and the sub-phonemic perception skills necessary for this learning. As most of these learning studies' explicit approaches depart from the non-explicit focus of the current study, a final strand will provide an overview of literature that explores the role of experience in second language perceptual learning. These three areas for review all relate to the topic of the current study and help to put the themes into perspective; however, none of the previous studies have focused on all of the aspects that make up this study. For this reason, none of the following studies relates to the current study entirely. Also for this reason, this study's focus addresses a gap in the literature.

2.2 Potential for Perceiving New Sounds in a Second Language

2.2.1 Trends in the Age Debate

The age debate is already forty years old, and the large number of recently published articles on the topic shows that the debate is unlikely to abate soon. The following discussion focuses on some seminal articles from this debate; however, this discussion is not exhaustive by any means. For many years, research suggested that adult second language learners could never achieve native-like standards in a non-native language. As further research was conducted, these limits on post-pubescent learners' L2 potentials were redefined according to the specific language skill. In these cases, still, adult learners' capacity for perceiving and producing new L2 sounds was severely limited. In recent years, some exceptions to post maturation effects have arisen in the

literature although these cases still represent outliers to the overall trends. A brief summary of this debate follows.

In a climate that valued biology and strictly scientific explanations, Penfield's (1965) findings about brain lateralization in childhood neural development provided a logical explanation for children's apparent facility and adults' apparent difficulty with language acquisition. This finding was used to explain both second and first language acquisition. In 1967, Lenneberg cited this biological constraint to support his Critical Period Hypothesis. Later studies, such as those that explored failed attempts at language acquisition in wild or confined children, (see Curtiss, 1977), provided further evidence to support Lenneberg's theory. In this way, late attempts at acquiring even a first language could not overcome biologically related limitations.

Soon afterwards, other research uncovered counter-evidence to the claims made by The Critical Period Hypothesis. Two important studies include Asher and Garcia's (1969) inquiry into the language acquisition of Cuban immigrants in Miami and Snow and Hoefnagel-Höhle's (1978) comparison of Dutch acquisition in native English-speaking adults and children. In both cases, adults and children appeared to possess similar acquisition potential in all linguistic realms except phonology. Thus, although substantial data cast doubt on The Critical Period Hypothesis's relevance to syntax and semantics, much research still indicated its importance in phonological acquisition. Meanwhile, Johnson and Newport's classic (1989) study reasserted Critical Period-related beliefs on the syntactic level; interpretations of these results suggested greater age-related constraints in general. It compared grammatical judgment in native Korean and Chinese-speaking adult and childhood learners of English. The findings showed a strong negative correlation between age of arrival and score in addition to a leveling off of acquisition levels in post-pubescent L2 learners. It thus supported the notion of a critical period for second language acquisition.

The Johnson and Newport findings greatly influenced prevailing thought about age effects and second language acquisition until 2001, when Birdsong and Molis replicated the study. In this replication, they changed two aspects of the method: they increased the number of total participants from forty-six to sixty-one and they focused on Spanish native speakers instead of Chinese/Korean native speakers. Although they, too, found a strong negative correlation between age of arrival and score, they also discovered post-maturational effects. This counter-evidence has reopened serious inquiry into post-pubescent L2 learners' potential in all realms of second language acquisition.

Closer scrutiny of the Johnson and Newport data – and more specifically, incorporation of uniform measurement increments in the charts and figures – revealed some outlying later arrivals who had achieved similar proficiency to earlier arrivals. Birdsong and Molis's findings also challenged Johnson and Newport's original claims that indicated sixteen years as the latest age of arrival for second language learners to achieve native-like L2 proficiency. The exceptions to this sixteen-year cut-off point may have stemmed from the more recent study's use of participants with a different native language background. However, as the Johnson and Newport study claimed that the Korean and Chinese data were generalizable to all language pairings, the Birdsong and Molis results qualified as valid challenges to Johnson and Newport's original claims. These findings provided evidence that post-pubescent L2 accent acquisition was, in fact, biologically possible. Accepting native-like phonological acquisition in adults, however, still required substantial empirical support. Some recent studies have provided this empirical support for small numbers of adult L2 learners who demonstrate exceptional facility for acquiring a new language's sound system.

2.2.2 Cases of Exceptional Learners

A number of other studies have found rare incidents of native-like accent abilities in adult L2 learners. Bongaerts *et al.* (1997, 1999) found instances of native-like British English production among three out of five high-performing Dutch native speakers who had learned English after age twelve. Neufeld (1977, 1978, and 1979) trained adult

English native speakers (with no prior exposure to Japanese or Chinese) to perceive and to produce short Chinese and Japanese phrases. Out of the twenty participants, the native speaker judges rated one as a native speaker (with a native-like accent) of both Japanese and Chinese; they rated two other speakers as native speakers (with native-like accents) of Japanese only. Novoa *et al.* (1988) provided a more qualitative look into a specific exceptional case. Although he had learned various languages (French, German, Italian, Moroccan Arabic, and Spanish) after age 15, the participant achieved native-like levels of proficiency in each of them. This proficiency included pronunciation. Schneiderman & Desmarais (1988) also presented evidence of two exceptional adult learners in which native French-speaking judges deemed the participants' L2 French accent to be native to a francophone country. Although these participants make up a small minority of post-pubescent L2 learners, their existence suggests that adults – under the right conditions – can maintain the perceptual and motor abilities necessary to perceive and produce new language sounds accurately.

From a theoretical perspective, Flege's (1995) Speech Learning Model (SLM) allows for some exceptional cases in which learners can overcome the limitations of later age of L2 onset. According to his model, these learners are somehow able to reactivate their ability to perceive sub-phonemically. Further analysis of this ability in adults will appear in a later discussion devoted to adult L2 learners' sub-phonemic perception. Best and her colleagues agree with Flege, and updates to her Perceptual Assimilation Model thus reflect this agreement (Best, McRoberts, & Goodell, 2001).

Flege finds empirical support for the allowances stated above in his (2004) collaboration with MacKay that compared early and late-arriving Italian native speakers' perception of Canadian English vowels. As expected, they found trends that correlated with age of arrival; more importantly, though, they also found notable exceptions. In some instances, later arrivals outperformed early arrivals. Although Flege and MacKay account for the low-level achievement among the early arrivals by citing their high

frequency of L1 usage, they link the high achievement among the later arrivals to exceptional individual perceptual abilities.

Although more recent rigorous studies with larger sample sizes do not list exceptional cases as the subject of their major findings, a look at some of these studies' data suggest that, indeed, individual differences play an important role in L2 perception. Pallier, Bosch, and Sebastián-Gallés (1997), for example, focus on the limitations of pre-pubescent L2 perception in a bilingual community. Although their data showed significantly different trends between the Catalan and Spanish native-speakers and their title claimed a "limit on behavioral plasticity," These researchers pointed out that, in fact, some of the individual participants exhibited native-like tendencies in both their L1 and their L2. In this way, their data suggest that the term, 'limit' is a misnomer; some participants appear to defy these limits.

Following this study, Sabastián-Gallés and Soto-Faraco (1999) focused on the Spanish-dominant Spanish-Catalan bilinguals whose vowel perception mimicked that of the Catalan-dominant participants. In this study, too, they placed attention on averages and general trends. Their research objective diverged from that of Pallier, Bosch, and Sebastián-Gallés (1997), however, by exploring participants' L2 attentional abilities. Also in this study, they found significant differences between Catalan-dominant and Spanish-dominant bilinguals. According to the researchers, this evidence strengthened Pallier, Bosch, and Sebastián-Gallés's conclusions about a lack of neural plasticity even in young L2 learners, and thus further suggested the impossibility of overcoming the limitations of the L1 phonemic categories. A closer look at the results, however, reveals large standard deviations among the Spanish-dominant bilinguals and a reference to one Spanish-dominant participant who outperformed the average Catalan-dominant bilingual. The number of additional Spanish-dominant participants who also performed at native-like Catalan levels is unclear. Thus, at least one participant – and perhaps a few more – defied the perceptual limits set by the overall trend.

Similarly, Flege and MacKay's (2004) comparison of accent among Italian immigrants who varied in their age of L2 (English) onset and their frequency of L1 usage found some individual exceptions to the significantly different age and usage trends. Bradlow *et al.* (1997) also listed further investigation into individual potential as an area for future research. They based this statement on the results of their examination of /r/-/l/ perceptual training's effects on Japanese native speakers' English production. They found that individual participants varied significantly in their abilities to learn, and that exceptional learners were not represented in the quantitative results.

In this way, exceptional case data have provided counter-evidence to the literature that suggests an absolute limit on adults' second language perceptual abilities. These findings help to validate the current study's focus on Brazilian adults' perception of English contrasts. Findings from the above reviewed literature thus do not place limits on these participants' performance. Furthermore, the above exceptions referred primarily to native-like levels of attainment whereas the current study focuses on improvement. The focus of the current study on significant improvement from low exposure levels rather adherence to native standards effectively lowers the standards for perceptual acquisition and raises the number of qualified participants.

2.3 Sub-Phonemic Awareness and Explicit Training Studies

2.3.1 Sub-Phonemic Awareness

Recall that Flege's SLM (1995) indicated these sub-phonemic perceptual abilities as a key to overcoming the limitations of L1-determined phonemic categories: successful L2 sound acquisition, he postulated, counted on the ability to reactivate continuous perceptual abilities. This ability, therefore, must have proven important for the aforementioned cases of exceptional learning. Likewise, sub-phonemic awareness played an important role in Brazilian adults' perception of English vowel contrasts. This ability thus needs to be established before a discussion about perceptual learning can take place.

When phonemic categories do not overlap between an L1 and an L2, learners must tune into acoustic cues that are sub-phonemic in their native language. Such is the case for this study's Brazilian Portuguese native speakers who try to perceive the English vowel contrasts, /i/-/I/ and /u/-/ʊ/. For this reason, adults' perceptual abilities at the sub-phonemic level prove highly relevant to this study. A cursory look at most perceptual studies in L2 contexts suggests that adults can perceive some sub-phonemic differences, although they rarely mirror native levels. Instead, these learners usually exhibit better-than-chance perceptual sensitivity to non-native contrasts (Polka, 1992; Pegg & Werker, 1997).

On the question of sub-phonemic awareness in second language acquisition, Ohala (1993) posits that second language learners – at least those trained in phonology – are less likely to perceive according to their native language-defined phonemic categories. Support for this claim comes from reports of phonologists who traditionally immersed themselves in an L2 environment to compile a list of the allophones and phonemes in its sound inventory. In these resulting lists, phonologists have tended to overstate the L2's number of allophones. Even if this tendency is limited to phonologists, it demonstrates the biological feasibility of reactivating continuous perception abilities.

Further examination of sub-phonemic awareness in adults, in fact, presents examples of its presence in participants who have not trained in phonology (Wode, 1994; Hayes, 2003). Specifically, Hayes points to Kuhl's (1991; Grieser & Kuhl, 1989) Perceptual Magnet Effect to provide evidence of adults' sub-phonemic awareness: participants demonstrated a significantly higher tendency to assign a prototype – rather than a peripheral phone – to a given phonemic category. Wode (1994) points to middle-aged speakers' ability to adapt to their communities' language changes, citing Labov's (1966) example of hyperarticulation in middle-aged New York women. These cumulative studies create a compelling case for sub-phonemic perceptual abilities in adults' first language.

In two additional examples, Wode (1994) extends his hypothesis to include adult L2 learners. His first example notes these speakers' production and perceptual adjustments in the direction of salient L2 acoustic elements that are irrelevant to their L1's phonemic categories. For adjustments in production, Wode draws attention to Flege and Hillenbrand's (1984) findings in which native French-speaking learners of English produced VOT values for English /t/ that fell in between common English and French values. For adjustments in perception, he points to Chinese native-speaking learners of English who, despite audible accents in their spoken English, could differentiate between native and non-native English speakers (Flege, 1992). His second example focuses on uniform approaches to acquiring new phonological elements despite different L1 phonemic backgrounds. According to one study, German and Spanish native speakers' early English production attempts resemble those of first language learners: all three groups substituted the American and British /r/ with /w/ despite three different linguistic backgrounds. With the sum of Ohala's, Hayes's, and Wode's observations, sub-phonemic awareness appears to play a role in adult L2 phonological acquisition. Thus, based on the parameters set by Flege's SLM, adults appear to possess the potential to overcome some age-related perceptual difficulties.

Further exploration of different L1 and L2 phonemic category mismatches, however, uncover some exceptions to the above findings. Specific phonemic contrasts present especially difficult perceptual tasks for speakers of certain languages. In these cases, the L2 categories map so closely onto (usually) a single L1 category that they trigger learners' L1 phonemic perception (Best, 1995). For example, native Japanese speakers perceive the /r/-/l/ contrast of English at near-chance levels (Goto, 1971; Logan *et al.*, 1991; Miyawaki *et al.*, 1975; Mochizuki, 1981; Sheldon & Strange, 1982; Yamada & Tohkura, 1992). Additional research highlights native English speakers' near-chance perception of the French contrast, /u/-/y/ (Levy & Strange, 2002) and tones of Thai (Wayland & Guion, 2001).

Thus, L2 listeners show evidence of sub-phonemic awareness as it applies to many non-native phonemic contrasts, but not all of them. Even among these more difficult contrasts, however, certain conditions can enhance sub-phonemic awareness. An explicit training module represents the most obvious type of condition.

2.3.2 Explicit Training Studies

2.3.2.1 Laboratory-Based Studies

Much of the literature from this area suggests that perceptual training can enhance L2 perceptual abilities significantly. Studies vary the non-native sound that serves as their primary focus; however, a large body of research focuses on Japanese learners' perception of the /r/-/l/ contrast of English. These learners' near-chance discrimination of this contrast prior to training provides a good baseline for measuring improvement. The most notable example of this type of explicit training study is a comprehensive four-part series that addresses Japanese native speakers' perception and eventual production of this American English contrast (See Logan *et al.*, 1991; Lively *et al.*, 1993; Lively *et al.*, 1994; Bradlow *et al.*, 1997). As a collection, these empirical inquiries provide some robust evidence to support training's effectiveness. The first study provides an opportunity to work out many of the methodological considerations at a strictly perceptual level. This process enhances the reliability of the fourth study, which replicates these methods in its perceptual portion. The second study analyzes the effects of talker variability on L2 perception; thus, it provides a link to real-life perceptual tasks in which listeners will need to attend to speaker-specific within-category phonetic differences. This study, along with the third study, also strengthens the series' reliability by focusing on a major criticism of explicit training studies. The second study moves beyond the confines of average Hz values whereas the third study addresses participants' long-term retention of the acquired categories.

Based on this type of extensive investigation, the variety of authors, and the opportunities for reflection, the eventual findings from the fourth study receive considerable mention in the literature. Specifically, the authors reported significant improvements in perception for most participants, especially in the identification of /l/,

the initially more problematic phoneme. The relatively equal accuracy with which participants identified /l/ and /r/ in the post-test, according to Bradlow and her colleagues, suggests that participants had begun to form separate phonemic categories by the end of their 45 hour, multi-stimuli training session. Furthermore, these participants were able to generalize across phonetic environments and could maintain this significantly improved ability for the six months that followed. These results suggest that some training conditions can improve L2 perception incrementally towards target L2 categories and, as such, trigger sub-phonemic awareness for even the most notoriously difficult L1-L2 mappings.

McCandliss *et al.* (2002) present another study in which Japanese speakers significantly improve their perception of the American English /r/-/l/ contrast under explicit training conditions. In this study, a group of participants was presented with exaggerated (adaptive) /r/-/l/ tokens while another group was presented with native-like (fixed) tokens of /r/-/l/. These two groups were further divided according to the feedback they received: half of the participants in each training setting received feedback and the other half did not. Training lasted for twenty minutes each day and continued for three days. For the participants who did not receive feedback, the adaptive training condition led to significant improvements in participants' perception; the fixed training condition did not. The influence of feedback was also significant: it accounted for significant improvements in both the adaptive and fixed training modes. Thus, manipulation of the data and/or explicit feedback accounted for significant improvements during this relatively quick training session.

The application of these results to real-life contexts, however, should not be overstated. For, as McCandliss *et al.* caution, participants' enhanced discrimination abilities did not generalize to different phonetic environments. Morosan and Jamieson (1989) also found such limitations in their study that used synthetic stimuli to train participants to perceive /θ/ and /ð/ in word-initial position. This training translated into improved discrimination of these sounds in natural settings. These natural settings,

however, needed to contain the target sound in word-initial position for any training effects to take place: training did not improve participants' discrimination of these two sounds in word-medial or word-final positions. Miyawki *et al.*'s (1975) research on Japanese speakers' discrimination of [r] and [l] found similarly limited applications of laboratory training to "speech-like stimuli." In this study, significant results depended upon the sounds' presentation method. When presented in isolation, Japanese learners of English discriminated between the two sounds with equal accuracy to English native speakers; however, Japanese learners only performed at slightly better than chance levels when the sounds were presented in native-like contexts. These three studies show a weakness of laboratory explicit training studies that have otherwise been considered successful.

2.3.2.2 Classroom-Based Studies

As a result of these limitations, the discussion continues with a look at some successful perceptual training studies that take place outside of the laboratory. Two notable classroom studies include Gonzalez-Bueno (1997) and Zybert (1997.) Gonzalez-Bueno explores this topic in her study of native English speakers' acquisition of Spanish stop consonants within the context of an intermediate-level Spanish conversation course. In it, training helps to enhance the effects of exposure significantly in two out of six instances. Zybert makes a strong case for the importance of explicit instruction in his (1999) study which explores Polish learners of English. In it, an experimental group that receives both implicit and explicit instruction perceive differences between English /en/ and Polish /en/ significantly better than the control group that does not receive this instruction.

The overall effectiveness of these classroom training modules, however, is also not straightforward. A lack of standardization across techniques and measurements has contributed to mixed results. For example, Elliot (1995) cites teachers' preferences for techniques that favor some participants' individual learning styles over those of others. Piske *et al.* (2001) notes that quantity and quality of training often differ considerably even within the context of similar approaches. In addition, many of the existent

significant improvements are short-term and do little to reshape the learners' phonological space (Derwing and Munro, 1997). For these reasons, this body of literature provides mixed support for classroom-based phonological acquisition. With these limitations of both laboratory-based and classroom-based perceptual training modules in mind, a look at the role of experience outside of the realms of explicit training becomes relevant.

2.4 Second Language Experience

Studies that outline the role of language experience in improving perception of L2 contrasts suggest that explicit training is not always necessary for overcoming L1-L2 perceptual overlaps. Accumulated language experience plays a dominant role in determining second language learners' ability to acquire new L2 categories that are initially perceptually equivalent to L1 categories. This influence is more specific than age of L2 onset even though it is often correlated with it. Learners who keep seeking out native L2 input often develop more accurate perceptual targets, which translate into more accurate production targets (Bongaerts *et al.*, 1997; Flege, 1995). Iverson *et al.* (2003) supports this idea with the notion of "neural commitment:" salient characteristics of a language's sound inventory reinforce themselves. The brain produces more synapses with greater numbers of perceptual or productive instances of a given sound; these synapses indicate a place in which to concentrate the input's focus. In this way, each cumulative language experience helps to wire the brain to perceive according to the phonetic characteristics that play important roles. Experience with a language provides such input.

As an example, non-explicit learning accounts for separate category formation of the much-noted /l/-/r/ contrast in Japanese learners of English. According to Flege, Takagi, and Mann (1995, 1996,) adult Japanese native speakers with twenty-one years of experience in the United States demonstrated significantly greater category formation for the phoneme, /r/, than their two-year U.S. resident counterparts. Guion *et al.* (2000) also explored Japanese native speakers' perception of English phonemes at various levels of experience. They, too, focused on American English /r/, but they also included the

contrasts, /θ/-/s/ and /v/-/b/. Although the group membership of the significantly different perceivers varied according to the specific phoneme, these findings suggest that implicit language learning can also aid the formation of perceptually difficult categories.

Flege, along with his colleagues, has undertaken a number of studies that assess the role of experience in L2 phonological acquisition. For the most part, they link experience to improved perception. For example, Bohn and Flege (1990) highlight the implicit learnability of perception. They used German learners of English at various stages of proficiency to test their perception of the contrasting and individual phonemes contained in the categories, /i/-/I/ and /æ/-/ɛ/. In this analysis, German contains the former contrast, but it does not contain the latter. German subjects demonstrated a uniformly high ability to perceive the native-like /i/-/I/ contrast, but a variable ability to perceive the non-native /æ/-/ɛ/ contrast. This variability showed an effect for proficiency level: perception of this non-native contrast improved as language skills improve. These skills have been acquired in the absence of explicit learning; therefore, exposure is responsible for these perceptual improvements.

Flege and MacKay's (2004) look at Italian-born Canadian immigrants provides further evidence to support the role of experience in L2 perception. In it, participants were separated according to their ages of arrival and their frequency of L1 usage. Trends revealed that, within their respective early or late arrival groups, participants who spoke Italian more frequently – and usually spoke English less frequently – did not perceive as well as their high-frequency English-speaking counterparts. According to these results, therefore, cumulative L2 language experience appears to play an important role in honing perceptual sensitivities to language-specific features.

In fact, some research suggests that these exposure contexts influence phonological acquisition in a greater way than more explicit learning contexts. According to Suter (1976) and Purcell and Suter (1980), co-habitation with a native speaker is the single greatest predictor of native-like accent acquisition. Furthermore, their findings

suggest that this context exerts a greater influence over L2 phonology than school, where foreign language learning can be more rule-governed. These results provide an example in which exposure accounts for phonological improvements. Based on the significant role that experience has played in second language learning, a non-explicit approach to language learning merits further investigation.

2.5 Conclusion

The preceding literature review has discussed three areas of research: L2 learners' potential for perceiving new sounds, results from explicit training studies, and implications from investigations into experience. The literature that is addressed in the first two sections helps to contextualize the current study's focus on perceptual improvements in adult non-native English speakers. The more recent literature suggests that some of the participants can hear sub-phonemically. These predictions are extended to Brazilians listening to English. The third theme, experience, helps to justify the study's focus on exposure related effects. The current study's focus on casual exposure in Brazilian Portuguese native speakers' perception of English contrasts is a new area of investigation that fits within the context of each of the three topics mentioned above; however, it also attempts to explore an issue that the literature has not yet addressed.

CHAPTER 3: RESEARCH METHOD

3.1 Introduction

The study investigated the effects of incidental contact with a second language on a non-native speaker's discrimination of foreign language vowel categories. Within the context of this study, Brazilian Portuguese represented the non-native speakers' first language; American English was the foreign language. Results from this investigation will help add to the literature about adults' perceptual abilities in non-native languages as well as fill the literature gap that does not address these abilities in terms of casual exposure. These results will also help to inform practices within the foreign language education classroom: they will hopefully provide greater insight into the relevance of perceptual training.

This chapter divides the components of the research method into four parts. First, the two research questions will help to pinpoint the specific line of inquiry. Further insight into the line of inquiry will come out of the second subtopic, which will describe the participants. Next, the research protocol will outline the procedures and instruments used to address these research questions. The data collected through the stated methods will provide input for the statistical measures. A description, justification, and breakdown of these statistical measures will appear in the final section.

3.2 Research Questions

The following research questions refer to participant groups and vowel contrasts. A thorough understanding of these research questions thus requires familiarity with the groups, the vowel characteristics, and these vowels' appearance in the vowel perception test. (A more complete description of the participants and instrument follow in sections 3.3 and 3.4, respectively. A more detailed analysis of Brazilian Portuguese vowels' mapping onto the American English vowel space appeared in 1.2.)

3.2.1 Background on the Research Questions

Five groups, each containing ten participants, took part in the study. Of these five groups, one group contained native American English speakers, and the other four contained native Brazilian Portuguese speakers. These four Brazilian groups varied from one another by English exposure level and/or place of residence. Brazilians living in Austin, Texas comprised two of these groups; Brazilians living in Belo Horizonte, Minas Gerais (Brazil) comprised the other two groups. The Austin-resident Brazilian participants were organized into high and medium contact level groups; whereas the Belo Horizonte-resident participants were organized into medium and low contact level groups. The list that follows helps to clarify the above description:

Group A: Native AE speakers (Austin, TX) [N=10]
Group B: Native BP speakers– high AE contact (Austin, TX) [N=10]
Group C: Native BP speakers– medium AE contact (Austin, TX) [N=10]
Group D: Native BP speakers– medium AE contact (Belo, MG) [N=10]
Group E: Native BP speakers– low AE contact (Belo, MG) [N=10]

The following AE vowels represented the study's primary focus: /ɛ/, /e/, /I/, /i/, /ʊ/, and /u/. Each of these sounds appeared an equal number of times in the vowel perception test. Of the instances in which each sound appeared, 50% of them occurred within the context of a minimal pair; the other 50% occurred within the context of an identical pair. For reliability purposes, both orderings of the vowel contrasts were represented equally. Thus, /I/-/i/, /i/-/I/, /i/-/i/, and /I/-/I/ each appeared fourteen times. The same breakdown applied to the other vowel groupings: /ɛ/-/e/, /e/-/ɛ/, /ɛ/-/ɛ/, /e/-/e/, /ʊ/-/u/, /u/-/ʊ/, /ʊ/-/ʊ/, and /u/-/u/ each appeared fourteen times. Together, these fourteen instances of each of the twelve possible combinations totaled 168 test items. (Refer to the end of Appendix A for an even clearer breakdown of these test items.)

These vowel pairings were chosen based on their mapping onto the BP vowel space. Recall from the discussion of vowel space in chapter one that the contrasts containing /i/ and /I/ likely mapped onto the single BP vowel category, /i/. Likewise, the

contrasts that contained /ʊ/ and /u/ likely mapped on the single BP vowel category, /u/. The distance between the prototypical values of the two vowels in each contrast was quite similar: the distance between /i/ and /I/ was roughly equivalent to the distance between /u/ and /ʊ/. These two vowel contrasts were also comparable to one another because each contained one tense sound, (/i/ or /u/), which was present in standard BP and one lax sound, (/I/ or /ʊ/), which was not present in BP.

The sounds, /ɛ/ and /e/, on the other hand, mapped on the AE and BP vowel charts quite similarly. As both BP and AE contained these sounds, Brazilian participants were expected to perceive their pairings at higher levels than the pairings that did not occur in their native language.[10] In this way, inclusion of this native contrast/pair provided a benchmark against which to compare the perception of the non-native sounds. Table 2 below shows these native vs. non-native distinctions.

Table 2: The Selected Vowel Pairings' Presence in American English and Brazilian Portuguese

Vowel pairings that exist in both SAE and SBP	Vowel pairings that exist in SAE but do not exist in SBP
/ɛ/-/e/	/ʊ/-/u/
/e/-/ɛ/	/u/-/ʊ/
/ɛ/-/ɛ/	/ʊ/-/ʊ/
/e/-/e/	/I/-/i/
/u/-/u/	/i/-/I/
/i/-/i/	/I/-/I/

With this greater understanding of the participants' groupings, the vowel pairings under scrutiny, and these vowel pairings' mappings onto standard Brazilian Portuguese, it is now possible to address the research questions. The first question addresses within-group differences; the second group addresses between-group differences.

3.2.2 First Research Question

1.) Within each group, do participants perceive the difference between the two vowels contained in the contrasts, /e/-/ɛ/ and /ɛ/-/e/, in a significantly different way than they are

[10] Refer to the discussion of Best's and Flege's analyses of second language perception in section 1.3 for a fuller description.

able to perceive the difference between the vowels contained in the contrasts, /ʊ/-/u/, /u/-/ʊ/, /I/-/i/, and /i/-/I/ when they appear in CVC nonsense minimal pairs? These data were examined for each group separately.

3.2.3 Second Research Question

2.) Do participants' differential abilities to perceive sounds from the six vowel contrast pairings vary significantly between Austin-resident native adult American English speakers (Group A), Austin-resident native adult Brazilian Portuguese speakers with high English contact (Group B), Austin-resident native adult Brazilian Portuguese speakers with medium English contact (Group C), Belo Horizonte-resident native adult Brazilian Portuguese speakers with medium English contact (Group D), and Belo Horizonte-resident native adult Brazilian Portuguese native speakers with low English contact (Group E)?

a.) Do these differential abilities to perceive the vowel contrast pairings, /i/-/I/ and /I/-/i/ vs. /ɛ/-/e/ and /e/-/ɛ/, vary significantly across groups?

b.) Do these differential abilities to perceive the vowel contrast pairings, /u/-/ʊ/ and /ʊ/-/u/ vs. /ɛ/-/e/ and /e/-/ɛ/, vary significantly across groups?

3.3 Participants

3.3.1 Guidelines for Participant Selection

Only adults participated in this study; their ages ranged from twenty to forty years old. For the Austin-resident Brazilian Portuguese speakers, the minimum age of arrival was twenty and the minimum length of stay in the United States was six months. Any potential participants with expressed hearing difficulties were excluded from the study. Similarly, any potential participants who had participated in musical training or had played any musical instruments did not qualify for participation. This criterion for selection came out of a pilot study in which musically trained participants significantly outperformed their non-musically trained counterparts. All Brazilian participants spoke

little to no English. Eligibility for participation relied on an inability to understand or speak some simple English phrases, especially those that employed a relative clause.

The study analyzed vowel perception by the five groups described in section 3.2.1. A measure of their cumulative and current English exposure levels determined their qualification for one of the contact groups. For this reason, the instrument for assessing these experience levels is relevant to a discussion about participant eligibility guidelines. This instrument will receive further mention in section 3.4.1.

3.3.2 A Note about the Medium Groups

A medium contact group appeared in both the Belo Horizonte and Austin-resident groups to assess the differences that existed between the Brazilian and the North American English language experience. Although the two groups possessed roughly equivalent levels of English contact, the type of English contact varied between the two groups. For example, most of the Belo Horizonte participants had heard English through music and films; only approximately forty percent of these participants had also heard English through exposure to social interactions.[11] The Austin-resident participants had generally had exposure to a greater variety of real-world, English-language contexts. For example, the language often played a role in their navigating the local bus system or grocery store. By measuring the difference between these two groups, it was possible to compare the Belo Horizonte and the Austin medium English contact experience. This comparison only helped to address any potential limitation caused by input differences: if a preliminary look at the results revealed no significant difference between these two groups' scores, then they would be collapsed.

3.3.3 A Note about the Participants

Gender, age, and attitudes towards English were not evenly distributed across the groups. However, the initial phase of data analysis attempted to gauge these variables' effects on both the within-group and between-group results. The categorization of

[11] Of these exchanges, most of them took place at the participants' job site. Frequently, these participants were hotel employees.

participants in terms of gender was straightforward: male results were compared to female results. The organization of participants according to their ages and attitudes towards English was specific to this study. Participants were split into four categories according to their ages; these categories ranged from 20-24, 25-29, 30-34, and 35-39 years of age. Participants' attitudes towards English fell within three different categories, specifically, positive, negative, and neutral. Thus, the initial phase of data analysis explored significantly different scores across each of the above-stated levels. Data analyses for the two research questions could only disregard these variables after ascertaining their irrelevance to the overall level-related data. (The specific statistical measures used to address these preliminary concerns and the two research questions will receive more thorough mention in section 3.5)

3.3.4 Achieving access to participants

The selection process was based primarily on a snowballing approach. Friends within the Brazilian Portuguese-speaking community supplied contacts within Austin's Brazilian community who satisfied selection criteria. Often, these participants recruited more participants for the study. Although some of the members of Group A were fellow students at the University of Texas at Austin, student status played no role in the selection process. In Belo Horizonte, most of the participants worked at or near the Federal University of Minas Gerais, where data collection took place. In this way, access was achieved through personal contacts at the research site. Additionally, students or former students who had taken phonetics or phonology classes were ineligible to participate in the study.

3.4 Research Design

3.4.1 Instrumentation

1.) Exposure Questionnaire

This instrument used information from a questionnaire to quantify Brazilian participants' cumulative and current exposure to English. The figures that came out of this quantification informed participants' placement within one of the two exposure groups, depending upon the given participant's place of residence. Belo Horizonte-

resident participants were eligible for participation in the Low and Medium contact groups; Austin-resident participants were eligible for the Medium and High contact groups. As this group classification did not apply to the native English speakers, this exposure questionnaire was only administered to the Brazilian native-speaking participants. This questionnaire was adapted from the questionnaire used in Flege and McKay's 2004 study that gauged frequency of language use among Italian immigrants in Canada. (A copy of it follows in Appendix B.)

In an attempt to standardize measurement, the responses to the questionnaire did not always appear directly on the data sheet. Instead, the researcher asked more questions when it was necessary to quantify vague terminology (such as "all the time") and to reexamine apparently conflicting data (such as "I work 75% of the week" and "I spend 50% of the week at the bar.") This approach was adopted because an earlier pilot study showed that free response alone produced widely varying interpretations for the same types of questions.

Data from the questionnaire assessed relative levels of exposure through a rubric. The rubric characterized individual exposure in terms of three levels: low, medium, and high. Specifically, the rubric rated the following types of exposure over time as it played out in participants' daily lives at home, at play, at work, at the store, at school, on the road, etc. The four categories in which exposure was assessed weighed differently, depending upon the participant's level of involvement. Guidelines for these different weights came from research by Purcell and Suter (1980,) which explored input from different contexts and their influence on accent. Specifically, these four categories included:

a.)Levels of exposure to American English when semantic context was unclear (For example, amount of time spent with American English television or radio in the background, amount of time in public English-speaking places, such as bars or restaurants.) [multiplied by the number of hours per day and the number of years of residence in The United States if applicable]

b.)Levels of exposure to American English in which semantic context is clear, but does not concern the participant (For example, exposure to work-related exchanges at work, discussions about food and prices at the supermarket, discussions about medicine at the doctor's office, etc.) [multiplied by the number of hours per day and the number of years of residence in The United States if applicable]

c.)Levels of exposure in which semantic context is important and participants are engaged, but they do not interact with English. (This section included examples from the previous one, although the focus of the situation was on the participants themselves. It also included instances in which participants wanted to understand the lyrics of English-language songs.) [multiplied by the number of hours per day and the number of years of residence in The United States if applicable]

d.)Levels of exposure in which the participant must interact (for example, in face to face exchanges, responding to "paper or plastic" at the grocery store and asking for directions when lost, in phone exchanges like bill inquiries, apartment hunting, and children's school) [multiplied by the number of hours per day and the number of years of residence in The United States if applicable]

In an attempt to represent, in a quantitative way, the greater influence on exposure levels that resulted from greater levels of English involvement, each of the above categories was assigned a number by which to multiply each given product. These numbers started at one (as in category a,) and increased by a multiple of 2 with each category that increased levels of involvement. This trend increased until category d, in which the category's final product was multiplied by 8. If a single participant referred to types of English exposure that qualified for multiple categories, his/her overall score came from the products of multiple categories. If an overall score fell between 4.0 and 10.0, the participant qualified for the relevant medium contact group. A score above 10.0 placed the participant within the high contact group; a score below 4.0 indicated the participant's placement within the low contact group.

See Appendix B for the interview questions and the questionnaire to assess levels of exposure. (A copy of the Portuguese version follows in Appendix C.)

2.) Training module

The researcher created a training module for the purposes of this study. The specific characteristics of this module came from consultation with David Birdsong, who provided information about standards of conventional training modules. The module required participants to perform the same-different task as they would later have to on the test. Specifically, it defined "same" as "same word in American English" and "different" as "different word in American English;" in this way, it provided a uniform criterion for participants and focused their attention onto the phonemic level. (This approach borrowed from Maye, 2000.) Although Brazilian participants did not speak any English, these criteria helped to define the task clearly.

In an effort to test participants' understanding of the task (instead of their discrimination abilities,) the minimal pairs in the training module contained vowel contrasts that did not appear on the actual test. Consistent to the actual test, however, were the vowels' acoustic distance from one another and the minimal pairs' percentage of voiced codas (50%.) The selected vowel contrasts came from the Portuguese and English contrast, /o/-/ɔ/; Portuguese-French contrast, /y/-/u/; and German contrast, /y:/- /ø:/. The selected same vowels came from Portuguese, /a/-/a/; French, /y/-/y/; and German, /ø:/-/ø:/.

This module allowed the participants to demonstrate their understanding of the instructions, adjust the volume if necessary, habituate themselves with the speaker's speech patterns, train themselves to respond within two seconds, and raise any possible questions. Participants finished the training module once they had correctly identified five of the pairs in a row. In three instances, participants needed to retake the training module before they correctly identified five pairs in a row. One participant could not

satisfy this criterion even after retaking the training module several times; he was excluded from the study.

3. Same-Different Vowel Perception Test

Roughly based on a similar instrument found in Strange and Dittman (1994), the vowel perception test consisted of a pre-recorded, twenty-minute, same-different task with no warning mechanism. The test was broken down into four parts: each portion contained forty-two comparisons that were separated by three fifteen-second breaks. According to results and participant feedback from the pilot study, these forty-two item groupings did not interfere with participants' ability to remain focused; the fifteen-second break time provided sufficient opportunity for participants to rest and to refocus for the following portion of the test.

Five hundred milliseconds (one 1/2 second) of wait time separated the two tokens in each comparison; two thousand milliseconds (two seconds) of wait time occurred between each pair. These interval lengths were informed by various sources. The interstimulus interval originally came out of a discussion with the phonetician, Scott Myers.[12] In assigning an interstimulus interval, we aimed to minimize wait time between test items while maintaining distinctions between each test item. Subsequent pilot testing showed that this interval allowed participants to make these distinctions once they familiarized themselves with the test's pace.

Guidelines for the intrastimulus interval came from Munnich and Landau (2003,) who cite Werker's (1995) observation that intervals longer than 1500 milliseconds impeded participants' ability to recall the preceding sound accurately. The resulting five hundred millisecond interval fit well within this guideline; its shortness also allowed for a shorter interstimulus interval and a less time-consuming test overall. Results from a pilot

[12] Developing a reliable same-different perception test was my specific focus in a semester-long phonetics course with Scott Myers. For this reason, all parameters for the perception test were approved by Scott Myers. In addition, Randy Diehl listened to the final product.

study and consultations with phonetics professors supported the use of this intrastimulus interval. (A script for this perception test appears in Appendix A.)

3.4.2 Data Collection Procedures

Step One:

The researcher first used a semi-structured interview to screen each prospective participant. Each screening focused on biographical information; specifically, questions addressed the participants' age, gender, birth place, musical inclinations, length of stay in The United States (for Austin-resident participants,) and attitude towards American English. Biographical data included city and state of origin, degree of contact with English speakers, previous experience with English classes, and listening abilities.

Step Two:

Participants responded to the exposure questionnaire. If potential Belo Horizonte participants exceeded the criteria for medium contact, they were excluded from the study. Likewise, if potential Austin participants did not meet criteria for medium or high levels of English contact, they, too, could not take part in the study.[13]

Step Three:

Following group placement, the researcher outlined the instructions of the vowel perception test in the speakers' native language. A practice module then allowed participants to master and to demonstrate their understanding of these instructions. Participants finished the practice module by responding correctly to five contrasts in a row.

Step Four:

Finally, participants listened to a pre-recorded same-different vowel perception task. As the instrument did not measure response times, the vowel perception test forced

[13] Such divisions between participants with different places of contact were motivated less by the literature than by practical considerations. Potential participants in Belo Horizonte that would have qualified for the High Contact group mostly exceeded the limits placed on English language ability. On the other hand, very few potential participants in Austin had exposure levels that qualified them for the Low Contact group.

quick responses with the 500 ms intrastimulus interval and the 2000 ms interstimulus interval. Participants were instructed to refrain from stopping or repeating the test, which could compromise the results of the forced choice approach.

Participants followed the same instructions as those from the training module. In the United States, testing occurred in private residences and offices; in Brazil, testing took place in a vacant cantina on the Federal University of Minas Gerais campus. In both countries, meeting times were set up according to the convenience of both the participant and the researcher. Each of these locations contained little background noise; headphone use helped to muffle any existent background noise further. As the following instructions indicate, participants wrote either 'D' for 'different' or 'S' for 'similar' to describe the relationship between the minimal or identical pairs that they heard. Participants wrote their answers on uniform answer sheets that contained the item numbers and blank lines that followed each item number. Results were calculated based on percentage correct in each of the vowel comparisons (12 vowel comparisons x 14 instances.)

The following script was read to each participant in his/her native language:
Directions: For each contrast, decide whether you think the two words would make up different or same words in American English. Indicate that they are the same by writing the letter, 'S', on the blank line next to the item number. Indicate that they are different by writing the letter, 'D' on the blank line next to the item number. Please do not attempt to replay the test items.

See Appendix A for the script of the training module and the vowel perception test.

3.4.3 A Note about the Method

The study assessed perception of minimal pairs in isolation from semantics as an attempt to investigate the lone effects of phonology. Although it is acknowledged that languages do not contain such context-free situations (and semantic ambiguities, although they exist, do not occur frequently), phonology-only input is quite relevant to many instances of second language perception in which the hearer does not understand the

language. In addition, empirical evidence supports this semantics-phonology separation: Hayes (2003) suggests that learners may use lexical differences when they learn to distinguish between minimal pairs, but that these differences do not remain when the learner stores the phonetic information. In addition, Maye (2000) found that distribution-based training could hone L2 learners' perceptual skills, and that they could replace lexical-contrast-based approaches. These findings lend support to this study's approach, which separated phonology from its semantic context.

3.5 Statistical Analyses: Description, Justification, and Breakdown

The patterns of results required non-parametric statistics; initial data plots showed trends that violated standards of normalcy. For this reason, the study used the non-parametric *Kruskall-Wallis ANOVA* to establish significance; post-hoc tests consisted of nonparametric *Mann-Whitney t-tests*. Testing that explored related variables used a non-parametric repeated measures ANOVA (*Friedman Test*) and its post-hoc counterpart, the *Wilcoxon Signed Ranks Test*. For a comparison of interaction effects' distribution between the five groups, a *Crosstabulation chart* and accompanying chi-square provided descriptive results.

Each participant's percentage correct provided the basis for an interval-scale score. A non-parametric ANOVA (Kruskal-Wallis Test) allowed research to focus on interaction effects of each of the independent variables. A non-parametric t-test (Mann-Whitney Test) helped to pinpoint areas of significance between relevant mean ranks. A non-parametric equivalent of the repeated-measures ANOVA, the Friedman test, allowed individual related scores to maintain their relationship to one another while allowing comparisons between them.

These three non-parametric measures varied from their parametric counterparts in one important way: they based comparisons on medians instead of means. To this end, the original data points (based on % correct) were substituted by their ranks relative to one another. This conversion of the data points normalized the distribution. All analyses

assessed differences across multiple participants or multiple vowel contrast pairings; therefore, *mean ranks* provided the basis for comparison (Hatch and Lazaraton, 1991).

Statistical measures focused on these mean ranks relative to the given group (for the first research question) or groups (for the second research question.) Individual ranks were recalculated within the context of each new comparison. Thus, the lowest rank for each comparison was one; the highest rank was equal to the total number of compared items. For the within-group comparisons, vowel contrast pairings represented these compared items; for the between-group comparisons, participants represented these compared items. The means of these individual ranks became the values that were associated with each group or contrast. Measures of significance, therefore, gauged the difference between these mean ranks.

Initial Kruskal-Wallis tests assessed the influence of three unmanipulated variables (gender, age, and attitude) on the manipulated variable (participants' scores.) If any significant differences arose from these comparisons, these areas underwent more specific Mann-Whitney Tests. The number of necessary post-hoc tests determined the necessary Bonferroni corrections. The one instance that found a significant relationship between an uncontrolled variable and participants' scores required the additional use of a Crosstabs test to assess this relationship's distribution across the relevant groups. Data gleaned from these Kruskal-Wallis, Mann-Whitney, and Crosstabs tests dictated these independent variables' inclusion in the measurements that evaluated the two research questions.

The first research question dealt with separate scores for each vowel contrast among the participants in each group. As each of the ten group members contributed a percentage correct for each of the twelve vowel contrasts/pairs, the results reflected repeated contributions from the same participants. For this reason, these related variables lent themselves to Friedman and Wilcoxon Signed Rank tests. The second research question assessed differences across groups. Participants from the five groups did not contribute to all of the five data sets; therefore, repeated measures did not serve as the

relevant statistical measures. Instead, Kruskal-Wallis and Mann-Whitney tests assessed differences between the groups' mean ranks.

3.6 Conclusion

This chapter has described the study's line of inquiry by stating the research questions, identifying its participants, outlining the research method, and presenting the statistical analyses. In an attempt to explore the effects of BP native speakers' casual exposure to AE, forty non-English-speaking Brazilians of high, medium, and low contact levels and ten native American English speakers took a same-different perception test that focused on three types of AE vowel contrasts. Two of these types of vowel contrasts existed in AE but not in BP; one of them existed in both languages. Non-parametric ANOVAS and t-tests assessed mean rank differences on 1.) the within-group level and 2.) the between-group level. The results of these statistical measures appear in the following chapter.

CHAPTER 4: RESULTS

4.1 Introduction

The following chapter will present the results of the previous chapter's methods. In an attempt to show more characteristics about the participants and to provide an overview of the data, the first portion will provide a look at the descriptive findings. The second portion will explore any effects of three potentially influential uncontrolled variables: these include gender, relative age, and attitude towards English. Following an assessment of these factors' influence, it will be possible to address the results vis-à-vis the research questions. The third portion, therefore, will revisit the two research questions. The fourth and fifth portions will list these results. These summaries of the results will begin with general overviews of the data sets and continue with more specific details. These data will contribute to the interpretations that appear in the discussion chapter.

4.2 Descriptive Findings

Five groups of ten participants took part in the study; fifty participants took part in all. Out of these fifty participants, twenty-seven (54%) were male and twenty-three (46%) were female. Each group, with the exception of the low contact group, contained five males and five females. The low contact group contained seven males and three females. Participants' ages across groups ranged from twenty to thirty-nine, with an average of 29.34. Within-group age ranges and average ages differed slightly across groups. Group A participants ranged in age from twenty-seven to thirty-eight and averaged 30.60 years old. In group B, the participants' ages ranged from twenty-two to thirty-seven, with an average of 29.30. At 29.10, group C participants' average age was nearly identical to that of group B, although the age range was slightly larger than that of group B (twenty to thirty-nine.) Group D contained the youngest average participants with an average of 27.90; these ages ranged from twenty to thirty-eight. Finally, Group E participants averaged 29.80 years old and ranged from twenty-three to thirty-eight years old. Table 3 (on page 44) will list these gender and age distributions both across all five groups and within each group.

In addition to participants' age and gender distribution, Table 3 also shows information about participants' attitudes towards English. This information came from the participants' self-reported judgments of their attitudes during the questionnaire. After collection, these data helped to assess any correlation between affective influence and participants' vowel perception scores. As the assessment focused on second language attitudes rather than first language attitudes, the participants in group A did not provide information about their attitudes. Thus, the English attitude data only applied to the four native Brazilian groups (Groups B, C, D, and E.) These attitudes qualified for one of the three following categories: positive, negative, and neutral. The number of participants with positive, negative, and neutral attitudes within each group will also be represented within Table 3 on the following page. These attitude assessments, along with the gender and age information, will contribute to findings in section 4.3, which investigates the effects of these uncontrolled variables on the participants' scores.

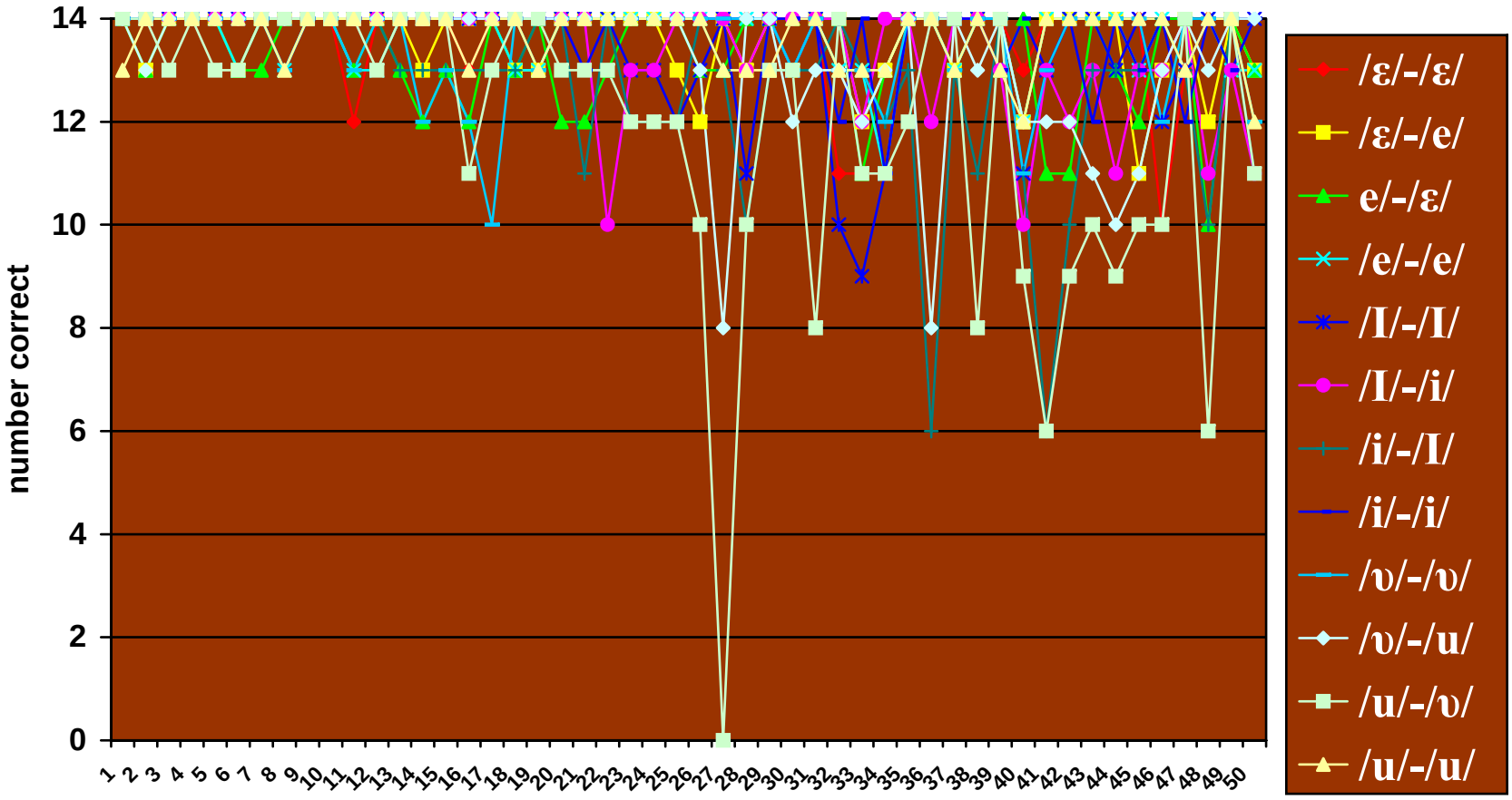
The fifty participants described above took a vowel perception test that contained 168 total items. The graph that appears in Figure 2 (on page 45) provides an overview of all of these participants' raw scores. As distinctions between specific vowel pairings proved central to the study's research questions, the vowel perception test data were organized according to these pairings. The 168 test-item total consisted of fourteen instances for each of the twelve vowel pairings. Figure 2 reflects this 12 x 14 breakdown: twelve different lines represent twelve different vowel pairings; a 0-14 range on the y-axis shows fourteen as the maximum number correct for each vowel pairing.

As Figure 2 shows, lower scores were more common among participants in Medium and Low contact groups whereas higher scores appeared more often among the Native and High contact group data. This pattern, however, was not uniform across groups or vowel pairings. It is interesting to note the areas of greatest perceptual difficulties within the Medium and Low contact groups: the /u/-/ʊ/ and /i/-/I/ contrasts presented the greatest challenge to accurate perception.

Table 3: Participant Characteristics

Characteristic		N	%	range	average	pos./neg./neut.
All Participants	50	100				
Females	23	46				
Males		27	54			
Age				20-39	29.3	
Group A (A.E. NS)		10	20			
Females	5	50				
Males		5	50			
Age				27-38	30.6	
Group B (High Contact-Aus)	10	20				
Females	5	50				
Males		5	50			
Age				22-37	29.3	
Attitude towards A.E.						5 / 1 / 4
Group C (Med Contact-Aus)	10	20				
Females	5	50				
Males		5	50			
Age				20-39	29.1	
Attitude towards A.E.						6 / 3 / 1
Group D (Med Contact-B.H.)	10	20				
Females	5	50				
Males		5	50			
Age				20-38	27.9	
Attitude towards A.E.						8 / 1 / 1
Group E (Low Contact-B.H.)	10	20				
Females	3	30				
Males		7	70			
Age				23-38	29.8	
Attitude towards A.E.						4 / 3 / 3

Figure 2: Individual Participants' Perception Test Scores for Each Vowel Pairing



Brazilian participants' placement within each contact group was determined by their place of residence and their scores from the exposure questionnaire (which assigned a score for length of exposure x amount of daily exposure.)[14] Among the Austin-based Brazilians, High Contact (Group B) participants received scores between 10.8 and 34.2 with an average score of 20.9; Medium Contact (Group C) participants' scores ranged from 4.1 to 9.7 and averaged 5.9. Among the potential Belo Horizonte-based participants, Medium Contact (Group D) scores ranged from 4 to 9.6 with an average of 5.5, and Low Contact (Group E) scores ranged from <.1 to 3.8 with an approximate average of 1.3. Although these numbers do not make sense outside of the scheme of this study, they serve an important function within this study: they help to provide direct comparisons between participants' contact levels. Tables 4, 5, 6, 7, and 8 display each participant's score from the exposure questionnaire for each group alongside their vowel perception test percentages. The tables follow in order of highest to lowest contact. As exposure questionnaire scores only relate to the Brazilian groups, exposure questionnaire scores appear in the last four charts. (Please refer to the following pages for these tables.)

In addition to individual exposure questionnaire scores, Tables 4, 5, 6, 7, and 8 also display data from the vowel perception test. As in Figure 2, these tables organize the scores according to individual participants' percentages for correct discrimination of each vowel pairing. These scores represent the number of correctly identified vowel pairings for each participant in each vowel category. Recall that percentages correct are based on number correct out of 14.

[14] For a review of the individual components that made up the exposure questionnaire score's product, see 3.4.1 in the previous chapter.

Table 4: Vowel Perception Test Percentages for Group A*

P #	/ɛ/-/ɛ/	/ɛ/-/e/	/e/-/ɛ/	/e/-/e/	/I/-/I/	/I/-/i/	/i/-/I/	/i/-/i/	/ʊ/-/ʊ/	/ʊ/-/u/	/u/-/ʊ/	/u/-/u/
1	100	100	100	100	100	100	100	100	100	100	100	92.9
2	100	92.9	92.9	100	100	100	100	100	100	92.9	100	100
3	100	100	100	100	100	100	100	100	100	100	92.9	100
4	100	100	100	100	100	100	100	100	100	100	100	100
5	100	100	100	100	100	100	100	100	100	100	92.9	100
6	100	92.9	92.9	92.9	100	100	100	100	100	100	92.9	100
7	100	100	92.9	100	100	100	100	100	100	100	100	100
8	100	100	100	92.9	100	100	100	92.9	92.9	100	100	92.9
9	100	100	100	100	100	100	100	100	100	100	100	100
10	100	100	100	100	100	100	100	100	100	100	100	100

*Percentages are based on the number of times that a given participant correctly identified the given contrast or pair as "Same" or "Different" (For each pairing, there are 14 total comparisons).

Table 5: Vowel Perception Test Percentages and Exposure Questionnaire Scores for Group B*

P#	*EQ*	/ɛ/-/ɛ/	/ɛ/-/e/	/e/-/ɛ/	/e/-/e/	/I/-/I/	/I/-/i/	/i/-/I/	/i/-/i/	/ʊ/-/ʊ/	/ʊ/-/u/	/u/-/ʊ/	/u/-/u/
11	*22.6*	85.7	100	92.9	92.9	100	100	100	100	92.9	100	100	100
12	*34.2*	100	100	100	92.9	100	100	100	100	100	100	92.9	100
13	*16.4*	100	100	92.9	100	100	100	92.9	100	100	100	100	100
14	*10.8*	100	100	92.9	100	100	100	92.9	100	85.7	100	100	100
15	*17.6*	100	100	92.9	100	100	100	92.9	100	92.9	100	100	100
16	*12.6*	92.9	100	85.7	100	100	100	92.9	100	85.7	100	78.6	92.9
17	*28.2*	100	100	100	100	100	100	92.9	100	71.4	100	92.9	100
18	*26.2*	100	92.9	92.9	92.9	100	100	92.9	100	100	100	100	100
19	*19.7*	100	92.9	100	92.9	100	100	100	100	92.9	100	100	92.9
20	*30.0*	100	100	85.7	100	100	100	100	100	100	100	92.9	100

*Percentages are based on the number of times that a given participant correctly identified the given contrast or pair as "Same" or "Different" (For each pairing, there are 14 total comparisons).

Table 6: Vowel Perception Test Percentages and Exposure Questionnaire Scores for Group C*

P#	*EQ*	/ɛ/-/ɛ/	/ɛ/-/e/	/e/-/ɛ/	/e/-/e/	/I/-/I/	/I/-/i/	/i/-/I/	/i/-/i/	/ʊ/-/ʊ/	/ʊ/-/u/	/u/-/ʊ/	/u/-/u/
21	*9.7*	100	100	85.7	100	100	100	78.7	92.9	100	100	92.9	100
22	*7.1*	100	100	92.9	100	100	71.4	100	100	100	100	92.9	100
23	*4.4*	100	100	100	100	92.9	92.9	85.7	100	100	100	85.7	100
24	*5.1*	100	92.9	92.9	100	100	100	100	100	100	78.6	71.4	100
25	*5.9*	100	92.9	100	100	85.7	100	85.7	100	100	100	85.7	100
26	*4.1*	100	85.7	92.9	100	92.9	100	100	100	100	92.9	71.4	100
27	*4.8*	100	100	92.9	100	100	100	92.9	100	100	57.1	0.0	92.9
28	*6.3*	100	92.9	100	100	78.6	92.9	71.4	100	100	100	71.4	92.9
29	*4.7*	100	100	100	100	100	100	92.9	100	100	100	92.9	92.9
30	*7.4*	100	92.9	100	92.9	92.9	100	92.9	100	92.9	85.7	92.9	100

*Percentages are based on the number of times that a given participant correctly identified the given contrast or pair as "Same" or "Different" (For each pairing, there are 14 total comparisons).

Table 7: Vowel Perception Test Percentages and Exposure Questionnaire Scores for Group D*

P#	*EQ*	/ɛ/-/ɛ/	/ɛ/-/e/	/e/-/ɛ/	/e/-/e/	/I/-/I/	/I/-/i/	/i/-/I/	/i/-/i/	/ʊ/-/ʊ/	/ʊ/-/u/	/u/-/ʊ/	/u/-/u/
31	*6.1*	100	100	100	100	100	100	92.9	100	100	92.9	57.1	100
32	*4.0*	78.6	100	100	92.9	71.4	100	100	85.7	92.9	92.9	100	92.9
33	*4.6*	78.6	85.7	78.6	92.9	64.3	85.7	92.9	100	92.9	85.7	78.6	92.9
34	*6.5*	78.6	92.9	92.9	78.6	78.6	100	85.7	78.6	85.7	92.9	78.6	92.9
35	*5.5*	100	100	100	100	100	100	92.9	100	100	100	85.7	100
36	*9.6*	100	100	100	100	100	85.7	42.9	100	100	57.1	100	100
37	*4.2*	100	92.9	100	92.9	100	100	92.9	100	92.9	100	100	92.9
38	*4.8*	100	100	100	100	100	100	78.6	100	100	92.9	57.1	100
39	*5.1*	100	100	92.9	100	100	92.9	100	92.9	100	100	100	92.9
40	*4.3*	92.9	85.7	100	85.7	78.5	71.4	78.5	100	78.5	85.7	64.3	85.7

*Percentages are based on the number of times that a given participant correctly identified the given contrast or pair as "Same" or "Different" (For each pairing, there are 14 total comparisons).

Table 8: Vowel Perception Test Percentages and Exposure Questionnaire Scores for Group E*

P#	*EQ*	/ɛ/-/ɛ/	/ɛ/-/e/	/e/-/ɛ/	/e/-/e/	/I/-/I/	/I/-/i/	/i/-/I/	/i/-/i/	/ʊ/-/ʊ/	/ʊ/-/u/	/u/-/ʊ/	/u/-/u/
41	*<0.1*	100	100	78.6	100	92.9	92.9	42.9	92.9	92.9	85.7	42.9	100
42	*<0.1*	100	100	78.6	100	100	85.7	71.4	100	100	85.7	64.3	100
43	*0.2*	100	100	100	100	100	92.9	92.9	85.7	100	78.6	71.4	100
44	*3.8*	100	100	92.9	100	92.9	78.6	92.9	100	100	71.4	64.3	100
45	*0.2*	100	78.6	85.7	92.9	100	92.9	92.9	92.9	100	78.6	71.4	100
46	*0.7*	71.4	92.9	100	100	85.7	92.9	100	100	85.7	92.9	71.4	100
47	*2.0*	92.9	100	100	92.9	92.9	100	92.9	85.7	100	100	100	92.9
48	*1.7*	100	85.7	71.4	100	100	78.6	71.4	100	100	92.9	42.9	100
49	*1.3*	100	100	100	92.9	100	92.9	100	92.9	100	100	100	100
50	*2.5*	92.9	92.9	92.9	92.9	100	78.6	78.6	100	85.7	100	78.6	85.7

*Percentages are based on the number of times that a given participant correctly identified the given contrast or pair as "Same" or "Different" (For each pairing, there are 14 total comparisons).

The above percentage data also contributed to the statistical findings; they served as the input for the non-parametric ANOVAs that addressed the research questions. An overview of the results from these ANOVAs will appear in section 4.4, which follows a brief discussion about the interaction effects of three uncontrolled variables.

4.3 Interaction Effects of Age, Gender, and Attitude on Score

4.3.1 Gender

Gender represented the first of the three variables to receive more intense scrutiny. A Kruskal-Wallis test that measured the influence of gender on scores' mean ranks found no effects for gender. Therefore, analysis of this study's data could continue without concern that gender differences had influenced the responses to the research questions.

4.3.2 Age

The literature has found negative correlations between age and perceptual levels. For this reason, this study limited its focus to adults whose ages fell within a twenty-year span of one another. Despite this limited focus, it was still acknowledged that ten, fifteen,

and twenty-year differences might play substantial roles in shaping perceptual abilities. Age effects, therefore, required closer study before attributing the within-group and between-group results to the effects of the manipulated variable. A nonparametric ANOVA compared participants' scores across four different age categories that spanned five years: these categories included ages 20-24, 25-29, 30-34, and 35-39. Based on the results of this ANOVA, relative age did not influence participants' scores significantly in any of the vowel contrasts/pairs. Therefore, further comparisons of participants' scores could disregard age as a factor.

4.3.3 Attitude

Attitudes towards the target language have been shown to influence language learners' facility for L2's acquisition. These attitude-related effects could prove particularly salient to the Austin-resident Brazilians, who have spent substantial time in an English-speaking environment, but have not yet learned to speak the language. For this reason, it was relevant to measure the influence of attitude on participants' scores. A nonparametric ANOVA compared participants' scores across the three categories for attitude, which included negative, neutral, and positive. A slight significance was found for attitude; therefore, it was necessary to gauge the distribution of attitude throughout the group levels. Table 10 (below) shows a cross tabulation chart and the results of a chi-square comparison that is based on this cross tabulation.

Table 9: Results of Contingency Table and Pearson Chi-Square for Level vs. Attitude

Level	Attitude			Pearson Chi-Square	Significance
	Neutral	Negative	Positive		
High Contact Austin:	40%	10%	50%		
Med Contact Austin:	40%	10%	50%		
Med Contact B.H.:	10%	10%	80%		
Low Contact B.H.:	30%	30%	40%		
Total:	30%	15%	55%	5.636	.465

According to the contingency table (on the previous page,) neutral, negative, and positive attitude levels were distributed in relatively similar ways in three of the four Brazilian Portuguese native-speaking groups: their individual group percentages fell within 15 % of the total percentage within level. The Medium Contact (Belo) group's attitudes, which deviated from the total percentages by more than 15 % in two of the three categories, did not represent a significantly different grouping of attitudes according to the chi-square. Based on these findings, there was a slight correlation between participants' attitudes and scores; however, attitude's relatively even representation among the four Brazilian groups did not alter level-influenced effects. As this study primarily focused on the effects of contact level, it was possible to disregard the effects of attitude in the subsequent exploration of the two research questions.

The preceding discussion's assessment of age, gender, and attitude effects on group scores suggests that these factors asserted very little influence over the data that related directly to the research questions. In the realm of age, no influence appeared: no significant differences characterized cross-age group comparisons of scores. In the realm of gender, this influence was limited to a vowel pair, /I/-/I/, that did not represent one of the six contrasts directly addressed by the two research questions. In the realm of attitude, significance was found; however, this result did not show any significant interactions with group levels. Based on these findings, it was possible to claim that age, gender, and attitude played no significant role in shaping the between-group and within-group level vs. score comparisons that defined the two research questions. With these factors' irrelevance established, the following discussion could focus exclusively on the answers to the two research questions.

4.4 Analyses Related to the Research Questions

4.4.1 Analyses Related to Research Question #1 (Within-group Differences)

This question attempted to evaluate participants' differential abilities to perceive the six contrasts, /ɛ/-/e/, /e/-/ɛ/, /I/-/i/, /i/-/I/, /ʊ/-/u/, and /u/-/ʊ/, within each of the groups.

For the purpose of these comparisons, native contrasts served as a baseline. Predictions that non-native contrasts would impede native-like perception formed the premise behind the perception test; however, these predictions addressed neither the severity of this effect nor the influence of different sound combinations. The data analyses associated with this research question attempted to address these issues. Friedman tests provided mean ranks and significance levels for all of the contrasts within each contact level. Table 10 presents an overview of the Friedman Tests that assessed perceptual differences between contrasts within each group.

Based on Table 10 (below), participants in the High Contact, Medium Contact (Austin), Medium Contact (B.H.), and Low Contact groups varied significantly in their abilities to identify the six vowel contrasts. This significance qualified these groups for further post-hoc examination. Specifically, the Wilcoxon Signed Rank Test compared within-group perceptions of each non-native contrast to the two native contrasts. These individual comparisons numbered eight and included /ɛ/-/e/ vs. /I/-/i/, /ɛ/-/e/ vs. /i/-/I/, /ɛ/-/e/ vs. /ʊ/-/u/, /ɛ/-/e/ vs. /u/-/ʊ/ as well as /e/-/ɛ/ vs. /I/-/i/, /e/-/ɛ/ vs. /i/-/I/, /e/-/ɛ/ vs. /ʊ/-/u/, and /e/-/ɛ/ vs. /u/-/ʊ/. Table 11 displays the results of the Wilcoxon Signed Rank Tests for each group that required post-hoc testing. The discussion that follows these two tables will attempt to contextualize the figures that appear in them.

Table 10: Results of Friedman Tests for Each Group*

	/ɛ/-/e/	/e/-/ɛ/	/I/-/i/	/i/-/I/	/ʊ/-/u/	/u/-/ʊ/	Diff:
Mean Ranks for Native English Group:	3.35	3.05	3.95	3.95	3.05	3.65	.124
Mean ranks for High Contact Group:	3.65	2.25	4.50	2.85	4.50	3.25	.003
Mean Ranks for Med. Contact (Aus) Group:	4.00	4.05	4.40	2.95	3.85	1.75	.007
Mean Ranks for Med. Contact (B.H.) Group:	4.30	4.45	3.80	2.75	3.30	2.40	.028
Mean Ranks for Low Contact Group:	4.65	4.05	3.55	3.20	3.80	1.75	.005

*Alpha=.05

Table 11: Test Statistics for the Wilcoxon Signed Rank Test: Individual Comparisons of Native vs. Non-Native Contrasts' for Each Relevant Group*

	/ɛ/-/e/ vs.				/e/-/ɛ/ vs.			
Group:	/I/-/i/	/i/-/I/	/ʊ/-/u/	/u/-/ʊ/	/I/-/i/	/i/-/I/	/ʊ/-/u/	/u/-/ʊ/
High Contact:	.038	.180	.083	.527	.015	.102	.015	.190
Med. Contact (Aus):	.666	.139	.399	.007	.861	.142	.336	.021
Med. Contact (B.H.):	.168	.027	.084	.027	.144	.028	.048	.027
Low Contact:	.087	.106	.115	.012	.631	.172	.719	.011

*Alpha=.05

4.4.1.1 Native English Group Results:

The ten participants in the Native English group did not differ significantly in their discrimination of the six vowel contrasts. The relatively close mean ranks and the P-value of .124 in Table 10 reflect this insignificant finding. The Native English group's statistically similar treatment of the six contrasts suggested that no contrast(s) provided a significantly different challenge to discrimination. This finding contributed to the validity of the test recording. With an insignificant overall P-value, this group did not require any post-hoc testing.

4.4.1.2 High Contact Group Results:

The next Friedman test assessed High Contact group participants' differential abilities to identify the six vowel contrasts. As this group represented the first non-native group to undergo analysis, these data served as a first look into the subject of the study's queries. According to Table 10, the p-value for the High Contact group comparison was significant at the .003 level. Based on this finding, the High Contact group perceived the six contrasts in significantly different ways. Post-hoc testing measured the significance of this effect between native and non-native contrasts. Table 11 shows the statistics for this Wilcoxon Signed Rank Test: the two non-native lax-tense contrasts, /ʊ/-/u/ and /I/-/i/, differed significantly from /e/-/ɛ/, their native tense-lax counterpart, at the .015 level.

Initial interpretations of this finding might lead to statements about these participants' differential facility for native vs. non-native perception. This native vs. non-native distinction is not straightforward, however, for two important reasons. First, the two significant p-values were based on negative ranks, which associated the greater perceptual challenges with the native contrasts rather than the two non-native contrasts. Clearly, this finding contradicts a-priory predictions. These findings presented a puzzling picture of the data; furthermore, attempts to interpret this picture did not add insight into the effects of exposure on non-native perception. A second challenge to a straightforward native vs. non-native distinction came from the pair-wise order effects that appeared in these data. Significant differences only arose in comparisons of lax-tense non-native contrasts to tense-lax native contrasts. These types of pair-wise order effects begin to appear with this group's analysis and continue to appear throughout the data. An examination of data from the other groups helped to determine whether these negative ranks and pair-wise order effects represented a greater trend or a break from a given trend.

4.4.1.3 Medium Contact (Austin) Group Results

To this end, a Friedman Test measured differences between Medium Contact (Austin) participants' discrimination of the six non-native contrasts. As seen in Table10, participants' scores in the Medium Contact (Austin) group converted to significantly different mean ranks for the six contrasts at the .007 level. From an informal look at the data, participants demonstrated greater difficulty with the non-native contrasts than with the native contrasts. After the previous finding, however, it was necessary to validate this claim as more than just hopeful speculation. For this reason, a Wilcoxon Signed Rank Test helped to associate this overall contrast with the individual comparisons that contributed to it.

The figures for the Medium Contact (Austin) group in Table11 show that the non-native contrast, /u/-/ʊ/, differed significantly from both of the native contrasts, /ɛ/-/e/ and /e/-/ɛ/, at the .007 and .021 levels, respectively. Unlike the significant differences found

in the previous contact group, the lower mean ranks represented the non-native contrasts; therefore, one could interpret these significant differences as participants' perceptual difficulties with this non-native contrast. In these data, the tense-lax combination of /u/ and /ʊ/ appeared more difficult for this contact group. This difficulty, however, seemed to be compounded by the contrasts' absence in Brazilian Portuguese. In this data set, pair-wise order effects also played a role. A more complete picture of these pair-wise order effects will take shape with analysis of further results.

4.4.1.4 Medium Contact (Belo Horizonte) Group Results

Of the remaining two groups, the Medium Contact (Belo) group was most similar to the group above. It became the next subject of scrutiny for its ability to provide greater insight into the results of the previous two contact groups. Table 10 shows higher mean ranks for the native contrasts and lower mean ranks for the non-native contrasts; these mean ranks differed significantly from one another at the .028 level. For this group, as with the previous two groups, the tense-lax combinations of the non-native contrasts presented greater difficulty than their lax-tense counterparts. The use of the Wilcoxon Signed Ranks Test helped to determine the significance of these observations.

The results of these tests, listed in Table 11, show that five out of the eight native vs. non-native comparisons differed significantly from one another. Of these five, the four lowest p-values represented differences between non-native, tense-lax contrasts and a native contrast. In this way, an order effect continued to appear. Similar to the results uncovered for their Austin counterparts, these findings highlighted participants' difficulty with the /u/-/ʊ/ contrast. Unlike the previous group's findings, however, additional contrasts and combinations also proved problematic, including the /ʊ/-/u/ and /i/-/I/ contrasts. Based on this and the previous data set, it is possible to state, at the very least, that the participants with medium levels of English contact identified significantly fewer instances of the /u/-/ʊ/ contrast than the /ɛ/-/e/ and /e/-/ɛ/ contrasts. A look at the Low Contact Group's results will help to determine whether these findings belong to a greater trend among lower contact groups.

4.4.1.5 Low Contact Group Results:

The Low Contact group represented the final group under investigation. Table 10 shows higher mean ranks for the native contrasts than for the non-native contrasts and a p-value of .005. Based on these figures, one or more of the non-native contrasts presented a significantly greater perceptual challenge than the native contrasts. In this way, individual comparisons between native and non-native contrasts merited further investigation. The Wilcoxon Signed Ranks Test results (in Table11) indicated this non-native contrast to be /u/-/ʊ/: it differed significantly from both native contrasts at .012 and .011 levels.

In this way, this group shared the two medium contact groups' difficulty with this contrast. Contrary to expectations that arose from the Medium Contact (Belo) group's scores and initial predictions that guided the study, these participants showed no significant difficulties with their discrimination of any other non-native combinations. Based on each group's areas of perceptual difficulties, an order effect appeared to compound the perceptual difficulties associated with the non-native /u/-/ʊ/ contrast. Within-group trends, however, did not reveal a pattern of perceptual difficulties for participants' discrimination of either ordering of the /i/ and /I/ sounds.

A look at trends between groups will help to the above findings in perspective. As these nonparametric tests used mean ranks to describe scores, a large amount of relativity characterizes the results. For this reason, identification of overarching patterns – such as those that help to identify exposure effects – required a framework that related each groups' data to those of the others.' Connections between these within-group findings and exposure effects will receive more thorough analysis in the following investigation.

4.4.2 Analyses Related to Research Question # 2: (Between-group Differences)

Within the context of the between-group design, a new dimension of analysis took place: results from the native vs. non-native contrast discrimination task came from all of

the groups. As the non-parametric ANOVAs were based on ranks instead of actual numbers, this distinction is quite important. In the case of the within-group data, the high and low ranks ranged from one to ten. This one-ten range appeared in each group; therefore, comparisons of mean ranks to those from other groups would have been misleading. In the case of the between-group data, however, analysis assessed highs and lows according to one data set that ranged from one to fifty. Thus, these ranks were directly comparable, and the results directly addressed contact-related differences.

4.4.2.1 Collapsing the Medium Contact Groups

The second research question grouped participants' scores according to their individual levels of contact. Although group divisions were based on level differences, two groups shared the medium contact label. Thus, these two groups could be viewed as one group. As outlined in the methods chapter, the use of two medium contact groups provided a direct comparison between Belo Horizonte and Austin-specific varieties of English input: an assessment of these two groups' differences served as a measure of reliability. This reliability needed to be established before the two groups could be collapsed. For this reason, the first cross-group comparison focused on the two medium groups' perception of the six vowel contrasts under investigation. A Mann-Whitney Test calculated the mean ranks for each of the six vowel contrasts across the two groups; an assessment of the differences between these mean ranks followed these calculations. Table 12 (on the following page) lists these figures.

According to Table 12, none of the mean rank differences between the two medium groups was significant for any of the six vowel contrasts. This statistical insignificance between the Austin and Belo Horizonte varieties of English input suggested that, indeed, the two contexts were comparable. Thus, a medium level of English contact in Austin, which most often took place during basic daily encounters with native speakers, influenced the participants' perception of the selected vowel contrasts in a statistically similar way to medium English contact levels in Belo Horizonte, which occurred in far more limited contexts. Despite differences between the contexts of

English exposure in Austin and Belo Horizonte, therefore, cross-resident comparisons still represented a valid measurement.

Table 12: Ranks and P-values for the Mann-Whitney Test: A comparison of the two medium contact groups' scores for the six vowel contrasts*

	Mean Ranks for /ɛ/-/e/	Mean Ranks for /e/-/ɛ/	Mean Ranks for /ɪ/-/i/	Mean Ranks for /i/-/ɪ/	Mean Ranks for /ʊ/-/u/	Mean Ranks for /u/-/ʊ/
Med. Contact (Aus.):	10.05	9.35	11.15	11.05	11.45	9.90
Med Contact (B.H.):	10.95	11.65	9.85	9.95	9.55	11.10
P-value:	.739	.393	.631	.684	.481	.684

*Alpha=.05

By establishing this reliability, it became possible to disregard some of the country-specific non-manipulated variables that could potentially compromise the data. Insignificant differences between the two medium groups thus attached greater reliability to all of the comparisons that spanned the two countries. As a result, non-parametric t-tests could assess differences between two groups that resided in two different countries directly: High Contact vs. Low Contact comparisons, for example, gained legitimacy.

With insignificant differences separating the two medium groups, distinguishing between them became unnecessary. Moreover, collapsing these two groups benefited this study by reducing the number of post-hoc Mann-Whitney Tests and raising the Bonferroni correction. For the purpose of more representative measures of significance, therefore, the two medium groups were collapsed into one. The following analyses incorporated this one twenty-member medium contact group into its comparisons.

4.4.2.2 Overall Between-Group Results

Overall results were determined by a Kruskal-Wallis non-parametric ANOVA, which compared participants' perception of the given vowel contrasts between groups. Upon discovering groups' significantly different perception of a given vowel contrast, additional post-hoc Mann-Whitney tests attributed significance to the appropriate group

comparisons. Unlike the comparisons that measured the non-manipulated variables and the first research question, the initial comparison to determine overall significance required only one Kruskal-Wallis Test. As this measurement did not require any divisions of the data, the number of data points was greater and no Bonferroni corrections were necessary. The alpha of .05, thus represented the criterion for significance for the overall non-parametric ANOVA. Table 13 (below) displays the results of these tests for all six vowel contrasts across the four contact groups.

Table13: Mean Ranks and P-values for the Six Contrasts Across the Four Contact Groups*

	Native English Group	High Contact Group	Med. Contact Group	Low Contact Group	P-value:
/ɛ/-/e/:	29.90	27.60	23.30	23.40	.477
/e/-/ɛ/:	31.20	19.65	28.58	19.50	.074
/ɪ/-/i/:	33.50	33.50	24.50	11.50	<.001
/i/-/ɪ/:	40.00	28.60	20.38	18.15	.001
/ʊ/-/u/:	33.05	35.00	21.38	16.70	.001
/u/-/ʊ/:	36.65	34.20	20.73	15.20	.001

*Alpha=.05

Post-hoc Mann-Whitney tests examined the source of each significant p-value more closely. As these values represented the difference between five groups, it was necessary to conduct non-parametric t-tests to assess the difference between each two-group comparison. These analyses measured figures from fewer participants, and these less robust data translated into necessary Bonferroni corrections. Six comparisons were necessary for identifying the groups that contributed to the significant results. These comparisons included Native English vs. High Contact, Native English vs. Medium Contact, Native English vs. Low Contact, High Contact vs. Medium Contact, High Contact vs. Low Contact, and Medium Contact vs. Low Contact. Based on this number of post-hoc tests, the criterion for significance was divided by 6. Only p-values that equaled or exceeded the .0083 alpha could qualify as significant. The results of these non-parametric t-tests appear in Table14 on the following page.

Table14: P-value values for Post-Hoc Mann-Whitney Tests for Relevant Contrasts*

Contrast:	Native English X High Contact	Native English X Med. Contact	Native English X Low Contact	High Contact X Med. Contact	High Contact X Low Contact	Med. Contact X Low Contact
/I/-/i/	1.000	.131	<.001	.131	<.001	.019
/i/-/I/	.004	<.001	.001	.069	.071	.601
/ʊ/-/u/	.317	.016	.005	.005	.002	.347
/u/-/ʊ/	.557	.002	.003	.009	.005	.175

Alpha=.0083

4.4.2.3 The /ɛ/-/e/ and /e/-/ɛ/ contrasts

The first two comparisons assessed the five groups' differential abilities to perceive the /ɛ/-/e/ and /e/-ɛ/ contrasts. According to cross-language vowel space comparisons, these two contrasts exist in both Brazilian Portuguese and American English. Pre-test hypotheses thus predicted similar perceptual performance among all five groups for these contrasts. This comparison represented an important analysis: it tested the philosophy behind the perception test which used these contrasts as constants. In thus doing so, this comparison also provided information about the test's validity. As Table 13 (page 59) shows, none of the groups perceived either of the two contrasts that involved /ɛ/ and /e/ significantly differently from any of the other groups: the p-values were .477 and .074 for the /ɛ/-/e/ and /e/-/ɛ/ comparisons, respectively. This finding followed the logic behind the perception which, based on a comparison of Brazilian Portuguese and American English vowel spaces, supported these contrasts' use as constants. In this way, these insignificant differences helped to contribute to the test's validity.

Results from the four other contrasts, /I/-/i/, /i/-/I/, /ʊ/-/u/, and /u/-/ʊ/, focus on vowel space distinctions that exist in American English, but do not exist in Brazilian Portuguese. The following portion of the discussion thus addresses the Brazilian participants' perceptual abilities of non-native sounds with reference to their levels of English contact. As Table 13 shows, cross-group comparisons for each of these contrasts

resulted in significant differences. Therefore, this discussion will reference information from both the non-parametric ANOVA as well as the post-hoc non-parametric t-tests.

4.4.2.4 The /I/-/i/ Contrast

Participants' differential perception of the contrast, /I/-/i/, opens the discussion about exposure's influence on non-native contrast perception. Unlike the /ɛ/-/e/ and /e/-/ɛ/ contrasts, participant groups with different contact levels showed significantly different abilities to perceive the non-Brazilian Portuguese contrasts. Table 13 (page 59) shows the overall p-values for this contrast to be quite strong: group scores differ from one another at the <.001 level. With the significance of this contrast established on a macro level, Mann-Whitney non-parametric t-tests attempted to identify the more micro-level (individual group) differences that contributed to the overall significant p-value. Table 15 (below) shows the p-values for this contrast across each of the four groups. The discussion that follows will address each of the group comparisons individually.

Table 15: P-values for Individual Group Comparisons of the /I/-/i/ Contrast (Overall significance = <.001)*

	Native English		
High Contact	1.000	High Contact	
Medium Contact	.038	.038	Medium Contact
Low Contact	<.001	<.001	.019

* alpha for post-hoc testing is .0083

A look at Table 15 lends itself to a discussion of differences as they pertain to each group comparison. First analyses included comparisons between the Brazilian Portuguese native-speaking groups' mean ranks and those of the Native English group. These preliminary explorations allowed an a priory look into Brazilian participants' degree of native-like perception.

The Native English and High Contact groups achieved identical results. According to Table 13, these identical results came from mean ranks of 10.50 for both groups; the subsequent non-parametric t-test indicated no difference between them. These data explain the 1.000 p-value that appear in Tables 14 and 15. Based on these results, this comparison did not contribute to the highly significant difference in the non-parametric ANOVA. High English contact levels, it appeared, provided sufficient perceptual information for non-native speakers to perceive /I/-/i/ in a native-like way. In order to measure the validity of this statement, it was necessary to address other non-native participants' performance in reference to the Native English group.

Based on the figures in Tables 14 and 15, the mean rank of the Medium Contact group, 13.75, and that of the Native English group, 19.00, did not differ from one another significantly (p-value = .038.) The mean rank difference between the Native English group and the Low Contact group, however, was quite significant: its p-value was <.001. Whereas the Native English group vs. Medium Contact group likely did not contribute to the overall significance, the Native English group vs. Low Contact group most definitely did. In this way, differential contact levels appeared to account for the groups' differential adherence to native-like perception standards in the context of the /I/-/i/ contrast. The influence of exposure levels among non-native English speakers thus merited further investigation.

In agreement with predictions from the Native English results, the Medium Contact group differed from the High Contact group at the insignificant .038 level and the Low Contact group differed from the High Contact group at the highly significant <.001 level. These results pointed to perceptual changes that occur during increased exposure to English. As the significant difference appeared to take place at an exposure level between the medium and low contact categories, a look at the difference between these two exposure groups is quite relevant.

According to Tables 14 and 15, the mean rank for the Medium Contact group,

18.00, was different from that of the Low Contact (Belo) group, 10.50, at the .019 level. Although this p-value was low, it did not qualify as significant according to the Bonferroni correction. Based on the above findings, exposure-related improvements to perceptual abilities did not appear to occur at a well-defined contact level between the low and medium contexts; however, they did appear to take place in a more gradual way. In this way, participants likely differed in their needs for improvement-inducing exposure levels.

Within the context of the /I/-/i/ contrast, exposure to English played a significant role in shaping participants' perception. In fact, high levels of English were sufficient for Portuguese native speakers to achieve the same results as native speakers. Participants with a medium level of English contact had likely learned from their exposure to English – the difference between high contact and medium contact groups was insignificant; – however, a p-value of .038 also showed that their perceptual abilities could not be characterized as identical to the Native English group. The Low Contact group's significantly different relationship to the High Contact group coupled with its insignificantly different relationship to the Medium Contact group suggested that exposure played an important role; however, the exact point at which exposure began to play a significant role could not be determined within the four-group scheme of this study. Individual participants likely varied in their sensitivity to perceptual cues: some required low-medium contact levels whereas some required relatively higher medium contact levels. This statement represents a degree of speculation; a less speculative finding attributes the Kruskal-Wallis significant difference to those that arose in the Low Contact group's comparisons to the Native English and High Contact groups.

4.4.2.5 The /i/-/I/ Contrast

With an overall significance at the .001 level, the /i/-/I/ contrast also required further post-hoc scrutiny. (Refer to Table 13 on page 59 to view this p-value and the relevant mean ranks.) Although the five groups' mean ranks listed in Table 13 followed the same order as those of the /I/-/i/ contrast, these mean ranks were distributed

differently. Most importantly, Native Speaker and High Contact groups received mean ranks that were far from identical to one another. In fact, the mean rank for the Native English group, 13.50, was significantly different from that of the High Contact group, 7.50, at the .004 level. (See Table14 for this p-value relative to those of the others.) Additionally, Table 16 (below) represents these data for this specific contrast.

Table 16: P-values for Individual Group Comparisons of the /i/-/I/ Contrast (Overall significance = .001)*

	Native English		
High Contact	.004	High Contact	
Medium Contact	<.001	.069	Medium Contact
Low Contact	.001	.071	.601

Alpha for post-hoc testing = .0083

As the figure for the High Contact group represented scores that were closer to those of the Native English group than any of the other groups, individual comparisons between the Native English group's mean rank and the two lower mean ranks of the other two contact levels, 20.38 and 18.15, also found significant differences. Table 16 shows these significant differences to be <.001 and .001 for the two comparisons. Thus, significant differences emerged in all comparisons that involved the Native English group. None of the other comparisons found significant differences: Table 16 shows that the High Contact vs. Medium Contact comparison contributed to a .069 p-value, the High Contact vs. Low Contact comparison contributed to a .071 p-value, and the Medium Contact vs. Low Contact comparison contributed to a .601 p-value.

Based on the six Mann-Whitney tests that addressed across-group differences in the perception of the /i/-/I/ contrast, the Native English group's significantly different mean rank accounted for the contrast's overall cross-group significance in the Kruskal-Wallis test. Native-like perception of this contrast appeared to require a higher level of

English contact than the previous contrast; this standard even surpassed that of the High Contact group. Thus, English exposure did not play a significant role in shaping non-native perceptions of this contrast. This finding suggested that a far greater gap existed between native and non-native perceptual abilities in the context of the /i/-/I/ contrast than the /I/-/i/ contrast.

4.4.2.6 The /ʊ/-/u/ Contrast

A look at the /ʊ/-/u/ contrast scores continued the test's examination of group exposure levels and their effect on participants' perception of non-native vowel contrasts. Table 14 shows the mean rank for each of the five groups and the significance level of the differences between these ranks to be significant at the .001 level. This value was quite similar to that of the /i/-/I/ and /I/-/i/ contrasts. Moreover, the mean rank order also followed that of the previous two contrasts: groups with higher levels of exposure generally received higher mean ranks. Further post-hoc testing made it possible to make more specific comparisons. Table 15 shows these figures for all four significant contrasts, and Table 17 (below) shows the results of this post-hoc testing that are specific to this comparison.

Table 17: P-values for Individual Group Comparisons of the /ʊ/-/u/ Contrast (Overall sig. = .001)*

	Native English		
High Contact	.317	High Contact	
Medium Contact	.016	.005	Medium Contact
Low Contact	.005	.002	.347

* alpha for post-hoc testing = .0083

Table 17 shows no significant difference between the Native English and High Contact groups. This finding is in line with the findings from the /I/-/i/ contrast despite a change in High Contact /Native English mean rank ordering. (See table 13 on page 59 for

specific values of these mean ranks.) Thus, although these two groups deviated from the general trend that would place Native English perceptual levels above those of the High Contact group, the insignificant difference between the two groups suggests that this deviation played no statistically measurable role. This finding altered the characterization of this contrast's overall trend by grouping the High Contact and Native English /ʊ/-/u/ data together. Further comparisons of both groups' mean ranks to those of the other groups showed the degree to which the High Contact and Native English differences played a role in determining relationships to other contact groups. Results from these comparisons helped to investigate the similar categorization of High Contact and Native English groups.

This investigation began with a look at the differences between the Native English group's mean rank and the two remaining groups' mean ranks. According to Table 17, the Native English group's mean rank did not differ significantly from the Medium Contact group's mean rank (p-value =.013.) The same table, however, shows a significant difference of .005 for the non-parametric t-test that compared Native English to Low Contact groups' mean ranks. Brazilian group scores gradually increased their difference from those of the Native English group as contact levels decreased: this negative correlation culminated in a significant difference between the Native English and Low Contact groups. In this way, Brazilian groups' exposure levels affected their ability to approximate Native English group scores.

A better understanding of this relationship between English exposure and perceptual ability required investigation into the differences between the remaining comparisons. A post-hoc test that compared the High Contact mean rank to that of the Medium Contact group found a significant difference between the two groups at the .005 level. Another non-parametric t-test found even greater significance in the High Contact vs. Low Contact comparison: the p-value reflected a significant difference between the mean ranks at the .002 level.

The importance of the significant differences that appeared in the two non-parametric t-tests above was two-fold: they provided further information about 1.) the similarity of High Contact and Native English groups and 2.) the relationship between exposure level and perceptual ability. In reference to the first point, a comparison of the Native English group's relationship to the Medium and Low Contact groups versus the High Contact group's relationships to these two groups provided more insight into the High Contact and Native English groups' similar classification. Whereas the Native English group differed significantly from the Low Contact group but not the Medium Contact group, the High Contact group differed significantly from both the Medium and Low Contact groups. This asymmetric relationship to the Medium Contact group suggested that the difference between the High Contact and Native English groups – despite its insignificance – shaped further group comparisons. This finding thus provided evidence that contradicted the similar grouping of the two contact levels. With this finding, the characterization of High Contact group scores as native-like lost some validity.

The second consideration that came from the above data addressed the perception-exposure correlation among the Brazilian participants. The significant difference from the previous high-medium contact group comparison already suggested a link between participants' exposure levels and their perception of the /ʊ/-/u/ contrast. The even more significant gap between the High Contact and Low Contact groups further contributed to this interpretation. An additional comparison between the Medium Contact and Low Contact groups thus provided some relevant information.

According to Tables 14 and 17, the Medium Contact group's mean rank did not differ significantly from that of the Low Contact group (p-value = .347.) This insignificant difference, coupled with the previous two significant differences, suggested that exposure effects primarily took place between medium and high contact levels for this contrast.

Results from five post-hoc non-parametric t-tests showed no significant

differences between Native English and High Contact groups' perception of the /ʊ/-/u/ contrast. In reference to comparisons to lower contact groups, however, the two groups only mirrored one another in one of two subsequent comparisons. Thus, the two groups could not receive identical classification: the High Contact group scored slightly higher than the Native English group. Within the realm of contact-based comparisons between Brazilian native-speakers, significant differences were found in the two post-hoc tests that included the High Contact group. These results suggested that greater exposure to English significantly enhanced the High Contact group's perception of the /ʊ/-/u/ contrast. A lack of significant difference between Medium and Low Contact groups showed little additional effect for exposure within these levels. Thus, English contact appeared to become influential between medium and high contact levels. Evidence for the above interpretations comes from the lack of statistical distinction between the High Contact and Native English groups and, simultaneously, the considerable statistical distinction between these two groups and the Low Contact group.

4.4.2.7 The /u/-/ʊ/ contrast

As with their perception of the three other non-native contrasts, the four contact groups also differed significantly in their perception of /u/-/ʊ/: Table 14 shows the p-value for this comparison to be .001. Similar to trends for previous vowel contrasts, their ranks also diminished as levels of English contact decreased. This comparability to the other non-native contrasts continued with the non-parametric t-tests that measured this trend's significance. Table 14 (page 60) displays the p-values for all four contrasts; Table 19 (on the following page) shows them for the /u/-/ʊ/ contrast specifically.

Table 18: P-values for Individual Group Comparisons of the /ʊ/-/u/ Contrast (Overall Sig. = .001)*

	Native English		
High Contact	.557	High Contact	
Medium Contact	.002	.009	Medium Contact
Low Contact	.003	.005	.175

*Alpha = .0083

The first comparison measured the difference between the mean rank of the native English group to that of the High Contact group. Table 18 shows that the Native English vs. High Contact group comparison resulted in an insignificant p-value of .557. In this way, the High Contact group performed similarly to the Native English group. This instance represented the third example of this similarity in the post-hoc testing for the four non-native vowel contrasts. Further post-hoc testing later measured this similarity's presence in comparisons to other groups.

The other two Brazilian groups' comparability to the Native English group's perception also proved relevant to the above discussion. In the Native English vs. Medium Contact comparison, the Native English group's mean rank differed significantly from the Medium Contact group's mean rank at the .002 level. The Native English-Low Contact comparison also resulted in a significant difference: its p-value was .003. (See Table 18 for a more complete summary.) The results of these three comparisons to the Native English group outline the Native English group's simultaneous similarity to the High Contact group and dissimilarity to the medium and low contact groups. In this way, contact level appeared to influence conformity or non-conformity to native-speaking standards for this contrast. Determining the degree of this influence required a look at the post-hoc results from the three native Brazilian group comparisons.

According to Table 18, the difference between the High and Medium Contact groups is close to significant; nevertheless, the .009 value cannot be considered significant according to the Bonferroni correction of .0083. Thus, it was not possible to establish any exposure-related effects between these two levels. The High Contact-Low Contact group comparison, however, found a significant difference at the .005 level. Although the High Contact-Medium Contact comparison did not find significance, the High Contact-Low Contact significant finding suggested that, indeed, participants' level of English contact helped to shape their perception.

An attempt to pinpoint the contact level at which exposure's influence took effect led to a look at the difference between the Medium and Low Contact groups. Based on the above information, the significant perceptual improvement occurred during an unspecified contact level between high and low contact. The above figures suggest that it did not occur exclusively between the Medium and High Contact levels. A look at the .175 p-value between the Medium and Low Contact groups also suggests that significant perceptual improvement did not occur exclusively between these two levels.
Unlike the figure from the High Contact-Medium Contact comparison, this p-value is not close to significant. Thus, one cannot attribute differential exposure effects to the period of contact between medium and low levels. More likely, it seems, the influence of English contact was not restricted to a finite period; instead, it likely occurred more gradually between various exposure levels.

A further measure of the exposure-perception link included a comparison of relationships. Specifically, these relationships included that of the High Contact group's mean rank to other Brazilian groups vs. the Native English group's relationship to these groups. As mentioned earlier, the two groups received mean ranks that did not differ significantly. These results led to similar characterizations of the two groups: high English contact levels appeared sufficient for Brazilian Portuguese native speakers to perceive the /u/-/ʊ/ contrast similarly to native English speakers. A comparison of the two groups' relationship to the Medium Contact and Low Contact groups further defined the

level of similarity between these two groups. For, one would expect virtually identical relationships to other contact groups if the two groups were virtually identical.

Based on the results of the four post-hoc non-parametric t-tests that dealt with these comparisons, the Native English and High Contact groups did not achieve entirely comparable results. Although both groups differed significantly from the Low Contact group (at the .003 and .005 levels, respectively,) significance varied between Native English-Medium Contact and High Contact-Medium Contact comparisons. Specifically, the Native English-Medium Contact group difference was significant at the .002 level; however, the High Contact-Medium Contact group difference was insignificant at the .009 level. Based on these data, exposure levels appeared to play an important role in shaping perception. It is not clear, however, that high contact to English provided sufficient input for Brazilian participants to perform in native-(English)-like ways.

This series of non-parametric t-tests for groups' differential perceptions of the /u/-/ʊ/ contrast provided further insight into English exposure effects. First, these effects at the highest level appeared sufficient enough to achieve native-like results. In addition to receiving mean ranks that differed from one another in a highly insignificant way, the High Contact group and Native English groups also achieved similar results in subsequent comparisons to the three other contact groups. Second, the difference between low contact and high contact mean ranks was significant. This finding suggests that greater degrees of English exposure helped to shape High Contact participants' perceptions; Low Contact group members lacked the enhanced perceptual ability that accompanied higher levels of English contact. From these findings, English contact differences appeared to have contributed to Brazilian Portuguese native speakers' differential abilities to perceive /u/-/ʊ/.

4.5 Conclusion

This chapter has presented the descriptive findings, the interaction effects of uncontrolled variables, the within-group results, and the between-group results that make

up the quantitative data. These data will serve as a reference for the following chapter, which will summarize the findings from both of the research questions. Within the scheme of this summary, connections within groups and across groups will receive emphasis. This big-picture perspective will lead to both practical and theoretical implications.

CHAPTER 5: DISCUSSION

5.1 Introduction

This study focused on adults' ability to develop perceptual skills in the absence of other target-language linguistic knowledge while in the presence of target-language input. Specifically, it addressed two two-vowel L2 contrasts that occupied the same vowel space as one native-language vowel category. Although it explored concepts linked to Flege and Best, these themes provided a starting point rather than a line of inquiry. It is true, the study's results add to the Flege and Best literature; however, L2 perceptual abilities among adults and the influence of L2 experience proved equally relevant to the research questions. (Connections between this study's results and those of previous studies will receive more detailed mention in section 5.4.)

Whereas previous studies have pointed out exceptions to age constraints, many of these findings have been limited to special individuals. The current study altered some of these previous studies' parameters to assess some level of these abilities' presence among a larger number of non-native speakers. In particular, these adjusted parameters included standards for comparison and demands on participants. Within the context of previous studies, native-like standards served as the relevant criteria for comparison; moreover, many of the studies' focus on production translated into relatively complex tasks. In light of these high demands on the non-native speakers, the emergence of very few outliers is not surprising. The current study attempted to evaluate larger trends associated with a less complex task (perception) and a lower criterion for comparison (statistically significant differences from other lower-contact non-native groups.) A look at the results indicates that individual differences likely played a role in this study as well; however, more global patterns also arose.

The following discussion will address the overall findings in reference to the research questions, draw conclusions from this analysis, and reflect on related observations. A look at these findings' implications for foreign language pedagogy will follow. Next, connections between this study's findings and those found in the literature

will receive mention. The final two strands will address the study's limitations and suggestions for further research.

5.2. The Research Questions Addressed:

5.2.1 Research Question # 1 (Within-group Analysis)

1a.) Group A (native English Austin-resident Americans):

As native speakers, participants from Group A helped to set the native criterion for perceiving the tested contrasts. These standards served two primary functions: they helped to expose the test's reliability and they provided a benchmark for comparison to the non-native groups. As a test that limited mean rank comparisons to the results within the same group, this measure helped to assess differential perception of individual contrasts, which could be used to address the test's reliability. (Establishing the strength of these results relative to the non-native groups, however, represented the domain of research question #2's between-group design.) If these speakers demonstrated significantly uneven difficulties with one or more of the contrasts, the test's faithfulness to native perceptual standards would lead to serious questions about this measurement. These questions would also apply to the non-native groups' results, which would likely compromise some (if not most) of the data.

Based on the findings in the previous chapter, however, this serious inquiry was not necessary: the native speakers performed in statistically similar ways across the six vowel contrasts. The .124 p-value defined the insignificant differences between mean ranks. The consistency that appeared in these participants' findings suggested greater test-related consistencies, which helped to uphold the test's reliability. In this way, the results pointed to a negative response to research question 1a: no, the eight comparisons under investigation did not differ significantly from one another within the native English-speaking group.

1b.) Group B (high contact Austin-resident Brazilians)

The High Contact group provided a first look into the non-native speakers' results. Viewed from this perspective, however, this look is somewhat misleading. For, the High Contact group's results did not reflect the trends that were later associated with the other two non-native groups. In addition, it was not possible to explain these anomalous results with reference to this group's extended exposure to English and, thus, enhanced perceptual ability; the results also deviated from the trends found in the native English-speaking group. Specifically, these participants' significant preference for /I/-/i/ and /ʊ/-/u/ over /e/-/ɛ/, both at the .015 level, departed from other native Portuguese-speaking groups' significant preference for native contrasts over /u/-/ʊ/ and the native English speaking group's insignificant preference for any of the vowel contrasts.

Attributing these results to their root cause represents a difficult – and rather speculative – task, although conjecture might point to perceptual overcompensation. Within the scheme of this explanation, the high contact group perceives both the native and non-native contrasts clearly. Recognition of the non-native contrasts as non-native, however, draws greater attention to them and away from the native contrasts. As a result of this disproportionate emphasis, the participants misidentify a significantly greater number of native contrasts than non-native contrasts. This process is aided by the vowels' tense and lax properties: results across the five groups associated greater difficulties with contrasts that followed a tense-lax order. In these ways, High Contact group participants' significantly better perception of the two non-native lax-tense vowel combinations over the native tense-lax vowel combination made more sense.

With the above analysis, it is possible to respond more thoroughly to research question 1b. Yes, participants from the High Contact group showed a significantly different ability to perceive the native contrast, /e/-/ɛ/, when compared to the non-native contrasts, /I/-/i/ and /ʊ/-/u/. In light of these participants' more successful discrimination of non-native contrasts, however, this significant difference did not directly add insight into perceptual effects of extended exposure to English. In addition to this affirmative response to the research question about two of the comparisons, the data also pointed to a negative response in reference to the other six comparisons that took place. High Contact

group participants showed no significant difference in comparisons of /e/-/ɛ/ and the two tense-lax non-native contrasts; nor did they demonstrate any significant differences in their discrimination of any of the four non-native contrasts when compared to the /ɛ/-/e/ contrast.

1c.) Group C (Medium Contact Austin-resident Brazilians)

This group's findings conformed more closely to expectations for non-native speakers. Based on the results from the other two non-native groups, these data also contributed to a trend across the three lowest contact groups. Like the High Contact group, these participants displayed significantly different abilities to identify a non-native contrast. In this case, however, the vowel contrast and the perceptual preference were different. The /u/-/ʊ/ contrast differed significantly from the native contrasts: it received mean rank scores that were significantly *lower* than the two native contrasts at the .007 and the .021 levels. Surprisingly, the contrasts that included the other non-native vowels, /i/ and /I/, did not present any significant discrimination difficulties. In this way, Austin-resident participants with medium contact levels displayed the greatest difficulty with the tense-lax combination of the contrast that included /u/ and /ʊ/; no other difficulties translated into significant differences.

With these findings in mind, it becomes possible to respond to research question 1c. Yes, the Medium Contact (Austin) group showed a significantly different ability to perceive the /u/-/ʊ/ contrast than both of the native contrasts, /ɛ/-/e/ and /e/-/ɛ/. In addition, no, the Medium Contact (Austin) group showed no significant difference in their ability to perceive the other three non-native contrasts as compared to the two native contrasts.

1d.) Group D (medium contact Belo Horizonte-resident Brazilians)

As a group that matched the previous group's relative level of exposure, one might also expect Group D's results to match those of Group C. Indeed, the Belo Horizonte-resident medium contact group also identified the /u/-/ʊ/ contrast with significantly less success than the two native contrasts at the .027 level. In addition to

these significant differences, however, this group also displayed significant difficulties with the other tense-lax non-native contrast, /i/-/I/: their mean ranks differed from the two native contrasts at the .027 and .028 levels. Finally, the group's perception of the /ʊ/-/u/ contrast qualified as significantly different from one of the native contrasts, /e/-/ɛ/ at the .048 level. In this way, the Belo Horizonte-resident group's results both reflected the trend established by its Austin-resident counterpart and added some new areas to supplement this trend. Although these two group's differential discrimination of /i/-/I/ and /ʊ/-/u/ might, at first glance, contribute to different characterizations of the two medium contact groups, it is important to note that this issue could not receive full mention without a direct comparison of the two groups' mean ranks, which occurred only in the context of the second research question.

Based on the above findings, the answer to the first research question is mostly affirmative. Yes, members of Group D displayed significant difference in their ability to perceive the /i/-/I/ and /u/-/ʊ/ contrasts relative to the two native vowel contrasts, /e/-/ɛ/ and /ɛ/-/e/. In addition, these members also displayed a significantly different ability to perceive the /ʊ/-/u/ contrast relative to one of the native contrasts, /e/-/ɛ/. The first research question also receives a negative response in reference to three comparisons. No, participants from Group D did not differ significantly in their ability to perceive the /ʊ/-/u/ contrast relative to /ɛ/-/e/; nor did they display any significant difference in their ability to perceive the /I/-/i/ contrast relative to either of the two native contrasts.

1e.) Group E (low contact Belo Horizonte-resident Brazilians)

The final group under investigation, Group E, reflected the lowest levels of English contact; consequently, it was also the recipient of the best-defined predictions. With little perceptual contamination from English, these participants were expected to adhere most closely to Best's and Flege's predictions of poor non-native contrast perception. As a group with less contact than Group D, these participants were expected to display the same or more areas of significant difficulty as the previous group. These great expectations, however, did not receive empirical support. Instead, the Low Contact group's results most closely resembled those of the Austin-resident Medium Contact

group. They continued the trend of significantly lower mean ranks for the /u/-/ʊ/ contrast relative to the two native contrasts; however, they did not reflect any additional significant differences. This deviation from theoretically-driven expectations requires a look back at the literature that initially formed them; these connections – or more accurately, deviations – will receive later mention in section 5.4.

The response to research question 1e mirrors that of research question 1c completely and that of research question 1d partially. Specifically, the participants of group E displayed a significantly different ability to perceive the /u/-/ʊ/ contrast relative to the two native contrasts. Also, the participants of group E did not display any significantly different abilities to perceive the other three non-native contrasts relative to the two native contrasts. The preceding discussion addresses significant differences in vowel perception abilities relative to individual group members; the following discussion assesses the continued presence of these differences across groups.

5.2.2 Research Question #2 (Between-Group Analysis) addressed:

Of the results from the six investigated contrasts, the two native contrasts contributed to insignificant cross-group mean rank differences whereas the four non-native contrasts contributed to highly significant cross-group mean rank differences. For this reason, post-hoc testing only assessed between-group mean rank differences in the context of the four non-native contrasts. A review of the patterns and exceptions that emerged from these non-parametric t-tests contributes to a full picture of the data, which, in turn, helps to answer the second research question. Overall, important observations emerged in two areas: these areas included the High Contact group's comparability to the Native English group and the Brazilian groups' relationships to one another.

The comparison between High Contact and Native English groups receives first mention. For three of the four non-native contrasts, – specifically, /I/-/i/, /ʊ/-/u/, and /u/-/ʊ/ – an insignificant difference separated the two groups. In addition, both Native English and High Contact group comparisons to the low contact group provided significant results in all three of the contrasts. The only obstacle to identical

characterizations of these two groups emerged in the differential significance levels for the High Contact-Medium Contact and Native English-Medium Contact group comparisons in two of the contrasts. These findings suggested that high contact levels of exposure to English increased the Brazilian participants' ability to perceive the contrasts, /I/-/i/, /ʊ/-/u/, and /u/-/ʊ/ to a level that was quite similar, but usually not identical, to that of native English-speaking levels.

Among the four non-native contrasts, therefore, only /i/-/I/ stood out as the contrast for which high levels of English contact could not contribute to nearly native-like perception. Instead, this gap between the Native English and High Contact groups showed signs of a different trend across group scores. Significant differences between Native English and all contact groups' scores, coupled with insignificant differences among all of the Brazilian groups' scores, suggested that exposure to English did not lend to significant improvements in the perception of /i/-/I/. In this way, the significantly higher Native English score accounted for all of the significance found in the initial Kruskal-Wallis test for this contrast.

With insignificant differences between Native English and High Contact groups for the /I/-/i/, /ʊ/-/u/, and /u/-/ʊ/ contrasts, it was necessary to look elsewhere to account for the significant values found for these contrasts in the Kruskal-Wallis test. As referenced above, both Native English and High Contact groups differed significantly from the Low Contact group in their perception of these three contrasts. Clearly, these comparisons accounted for much of the overall significance. In fact, they contributed to all of the significance for the /I/-/i/ contrast. For each of the /ʊ/-/u/ and /u/-/ʊ/ contrasts, one additional comparison added significance: the High Contact-Medium Contact difference for /ʊ/-/u/ was .005 and the Native English-Medium Contact difference for /u/-/ʊ/ was .002. None of the Medium Contact-Low Contact group comparisons found any additional significance. These results suggested that the Brazilian participants' perception of the /I/-/i/, /ʊ/-/u/, and /u/-/ʊ/ contrasts improved significantly with increased exposure to English.

These findings provided adequate information to address the second research question. As the Kruskal-Wallis test did not uncover significance for the two native contrasts, /ɛ/-/e/ and /e/-/ɛ/, evidence from these contrasts supported the null hypothesis. The four non-native contrasts, /I/-/i/, /i/-/I/, /ʊ/-/u/, and /u/-/ʊ/, however, all received significant p-values in the Kruskal-Wallis test. Based on these figures, it was possible to reject the null hypothesis for the four non-native contrasts. Within these four contrasts, significance was distributed differently. For the /i/-/I/ contrast, differences between native and non-native English groups accounted for the significance. The Native English vs. Low Contact comparison also played a role in the other three contrasts' significance; however, additional significance also came from comparisons between contact levels. Thus, it is possible to base these three contrasts' rejection of the null hypothesis on exposure-related effects.

5.2.3 Conclusions drawn from both of the research questions

Within each of the three lower level contact groups, participants earned significantly lower scores – which translated into significantly lower mean ranks – when they encountered the /u/-/ʊ/ contrast than either of the native contrasts. The Belo Horizonte-resident Medium Contact group also exhibited difficulty with the discrimination tasks of /i/-/I/ and /ʊ/-/u/ relative to one or both of the native contrasts. These results proved somewhat surprising: expectations for Brazilian participants outlined equal difficulty with all four non-native contrasts because of their equidistance within the vowel space.

An attempt to explain uneven preferences for specific non-native vowels leads to various areas of scrutiny. The first area includes the instrument itself, which could contain recording flaws. Specifically, one may hypothesize that, despite adherence to a pre-determined frequency range, the /i/-/I/ and /I/-/i/ vowel contrasts received more consistent or prototypically salient treatment than the /u/-/ʊ/ and /ʊ/-/u/ contrasts. This possibility becomes less likely, however, in light of native English speakers' insignificant preference for one vowel contrast over another. An argument that would not be deterred by this observation – namely, that native speakers often perceive their own phonemes

more categorically than do non-native speakers – is, in fact, deterred by most of the Brazilian Portuguese native-speaking participants' similar facility for discriminating between the two non-native vowel contrasts.

Two more likely explanations for some participants' uneven treatment of /I/ and /ʊ/ words address the Brazilian participants' perceptual abilities more directly. One hypothesis entails test-taking strategies: perhaps participants correctly identified one of the two non-native vowels early in the test and thus placed particular attention on that vowel throughout the rest of the test. In doing so, these participants failed to identify the other vowel as non-native and to focus the same type of attention onto the contrasts/pairs that contained it. This explanation becomes more plausible in light of observed learning effects across the results: many participants, especially those with higher error rates, demonstrated disproportionately greater difficulty with the first forty-two test items than with the remaining 126 items. During this initial learning period, the hypothesis follows, these eight participants only learned one of the two non-native sounds. Seven of these eight participants may have borrowed from their limited exposure to English to pinpoint the non-native sound: they favored the contrasts/pairs that contained the /I/ and /i/ sounds, which occur more frequently in common American English words than the /u/ and /ʊ/ contrast.

Returning to the broader perspective of the overall trends, the Belo Horizonte-resident Medium Contact group scored most similarly to expectations of the three groups. Nevertheless, two important aspects of the pattern emerged. When Brazilian participants with low or medium exposure levels misidentified non-native contrasts, they showed the most difficulty with 1.) the tense-lax combination and 2.) the vowel contrast that contained /ʊ/. These difficulties, it seemed, arose from lower levels of contact. This association, however, only received empirical support within the context of the second research question.

Results that arose in the investigation of the second research question supplemented the above information by directly comparing vowel contrasts' mean ranks

across the five groups. These comparisons helped to assign relative mean ranks that allowed for a relative ordering of the five groups' results. According to the non-parametric ANOVA's assignment of mean ranks for each contrast across the five groups, all four non-native contrasts differed significantly across groups. In all four of the cases, a significant difference separated the native English speakers' scores from those of the low contact group. In three of these four cases, a significant difference also separated the High Contact and Low Contact groups. These data suggested that English contact significantly affected participants' ability to identify the three non-native contrasts, /I/-/i/, /u/-/ʊ/, and /ʊ/-/u/. In the case of the /i/-/I/ contrast, a significant gap emerged between High Contact and Native English speaker mean ranks. This finding contributed to the following overall interpretation: English contact significantly enhanced discrimination of the three vowel contrasts, /I/-/i/, /u/-/ʊ/, and /ʊ/-/u/ to the extent that Native English and High Contact groups were statistically similar to one another and different from the Medium and Low Contact groups; however, English contact did not significantly improve Portuguese native speakers' discrimination of the /i/-/I/ contrast.

A possible challenge to the above interpretation may come from a challenge to the perception test itself. Created exclusively for this study, it did not undergo rigorous tests of reliability and validity through repeated independent use. Its development, however, incorporated methods used in other perception tests and insight gained through pilot testing. In addition to this information that contributed to the test's creation, the test's results helped to support its reliability in both the within-group and across-group contexts.

Among the data uncovered in the within-group measurements, the native English group's statistically similar treatment of the six contrasts suggested that none of the contrasts – including the /u/-/ʊ/ contrast – deviated significantly from native perceptual norms. These native perceptual norms extended to the Portuguese native-speaking groups in the results from the between-group comparisons: these groups' mean ranks for the native contrasts, /ɛ/-/e/ and /e/-/ɛ/, were statistically indistinguishable from those of the Native English group. In this way, the contrasts that received the label, "native contrasts,"

provided evidence that, like the native English speakers, all of the other participants perceived these two contrasts at similarly high/ native-like levels. These observations suggested that the test measured the material that it claimed to measure across a fifty-participant sample size.

An additional challenge to the findings could arise in light of the High Contact group's idiosyncratic within-group results. Indeed, these results created new questions of their own. Within the context of a within-group comparison, these data provided a considerable challenge to interpretation. This group's significant preference for two non-native vowel contrasts over a native contrast could even serve as counter-evidence to the above support for the test's reliability. Perhaps this group's dissimilarity from the other three Brazilian groups represented the only clear-cut finding. However, in light of the study's emphasis on exposure effects, this distinction from the lower contact groups made some sense.

In light of the results from the second research question, in fact, this distinction made even more sense. Within the between-group scheme, the mean ranks assigned to this group's scores fell above those of the medium and low groups; this difference was significant in three cases. The puzzling data from the within-group results – specifically, the High Contact group's significantly high discrimination rates for /I/-/i/ and /ʊ/-/u/ over /e/-/ɛ/ – translated into significant differences from Medium and Low Contact groups and insignificant differences from the Native English group for the non-native contrasts. In terms of the native contrast, the High Contact group's lower mean ranks did not translate into any significant differences across all of the groups. The mean ranks assigned to the High Contact group in the between-group results thus fell within a relatively orderly trend. These data helped to add order to the within-group results in addition to providing insight into the effects of incidental contact. In this way, the between-group results helped to assuage concerns that stemmed from the within-group results. As these results reflected scores from fifty participants instead of ten, their greater degree of robustness granted them greater authority than their within-group counterparts.

This investigation's findings provided a look into the relative effects of American English contact on Brazilian Portuguese native speaker's perceptual development. The data indicated three contrasts that could undergo significant perceptual improvement through increased contact and one contrast that could not; moreover, the data suggested periods during which significant perceptual development took place. In the case of the /I/-/i/ and /u/-/ʊ/ contrasts, significant differences separated neither the High Contact-Medium Contact nor the Medium Contact-Low Contact comparisons. Instead, they appeared only in light of the High Contact-Low Contact comparison. These data suggested relatively gradual perceptual learning. The case of the /ʊ/-/u/ contrast, however, presented a less gradual learning process: significant perceptual enhancement took place between the Medium and High Contact groups. The one contrast that seemed relatively impervious to contact's influence, /i/-/I/, only received significantly different scores between the Native English and High Contact group scores. These data complete this study's portrait of the participants' perception of the four non-native vowels from a quantitative perspective. Some additional insight arises, however, when the data receive a more qualitative analysis.

5.2.4 Discussion of Related Observations (and the Importance of Individual Differences)

Individual differences played a larger-than-expected role in shaping the results. It is true, the statistical measures presuppose a degree of variability, and the following discussion of individual differences does not nullify the quantitative findings; however, a well rounded view of the data requires a qualitative perspective that supplements the study's expressed quantitative approach. This perspective reveals some important deviations from the discovered trends, suggesting that, perhaps, individual perceptual abilities should gain greater emphasis. Although the following observations find little representation in the statistical findings, their presence has important ramifications for the theoretical realm, the applied realm, or both. The following account attempts to identify these imbalances and to represent them more equally. Three categories of observations merit special attention. Specifically, these categories include individual participants' 1.) disproportionate ability to discriminate one non-native vowel contrast over another, 2.)

native-like facility for perceiving both native and non-native contrasts despite low levels of English contact, and 3.) extremely high error rates relative to those of other members of the same group.

The first observation occurred with a look at the raw data for participant 7 of the High Contact group; participants 2, 4, and 7 of the Medium Contact (Austin) group; participants 1 and 8 of the Medium Contact (Belo) group; and participants 3 and 8 of the Low Contact group. (See Appendix D for a comprehensive view of the raw data.) In contrast to other participants' error rates, these eight participants favored one non-native contrast over the other, despite the two non-native vowels' similar distance to their respective native counterparts within the vowel space. Whereas the majority of the non-native participants showed more difficulty discriminating the pairs/contrasts that include /ʊ/, this pattern was not uniform: participant 2 of the medium contact (Austin) group, for example, displayed greater difficulty with the contrasts that included /I/.

The within-group results reflected some participants' greater difficulties with the /u/-/ʊ/ contrast; however, they neglected to include two other trends, including 1.) evenly distributed perceptual preferences among the majority of the participants and 2.) /I/-contrast discrimination troubles among a small minority of the participants. Although all three trends – specifically, increased difficulties associated with the /I/-contrasts, /ʊ/-contrasts, and neither contrast – appeared in the raw data, the final within-group data focused primarily upon the difficulties associated with the /u/-/ʊ/ contrast. Among the between-group results, different findings led to a similar shortcoming: a focus on the four non-native contrasts overshadowed some individual preferences for one type of contrast over another. By only highlighting one significantly greater trend in the data, the quantitative results did not call attention to the participants who deviated from these trends. The importance of these varying vowel preferences will be addressed further in reference to both the literature and the classroom.

Deviations from the trends established in the official results also relate to a discussion of the second and third observations. In both situations – namely, in which

individuals performed far better (2) or far worse (3) than the average – individuals showed instances in which the overall trends did not represent their perception. Quite simply, different people appeared to perceive differently. A more qualitative look at these data helps to support Repp's (1983) characterization of perception as "idiolectal;" the following examination of these statistical outliers will shed some light on this assertion. Additional connections to other relevant theoretical perspectives will follow this discussion.

A small number of low and medium-contact participants perceived the test items with similar accuracy as some native American English participants. A look at the raw data shows these instances with greater clarity. Participant 9 in the Medium Contact (Austin) group misidentified three different contrasts, namely, one /i/-/I/, one /u/-/ʊ/, and one /u/-/u/; participant 5 in the Medium Contact (Belo) group misidentified one contrast once, /i/-/I/, and one contrast twice, /u/-/ʊ/; participant 9 in the medium contact (Belo) misidentified one instance each of four different contrasts, specifically, one /ɛ/-/e/, one /I/-/i/, one /i/-/i/, and one /u/-/u/; and participant 9 in the low contact (Belo) group made three total mistakes, including one /e/-/e/, one /I/-/i/, and one /i/-/i/ contrast. Learners' characteristics, such as age, English attitude, gender, and musical facility, could not account for these native-like perceptual abilities.

The assertion that these scores are native-like comes from a direct comparison to the native American English group: three of the ten native American English speakers also made three or four mistakes. Although the native English results varied from those of the native Portuguese in the types of vowels that created discrimination errors – Native English discrimination difficulties lay more frequently in the pairs/contrasts that contained the /e/ and /ɛ/ sounds (these represented six out of eleven total mistakes) whereas the Brazilian Portuguese participants were more likely to misidentify non-native sounds (these represented eight out of thirteen total mistakes,) – both sub-groups received similar scores. As overall data from the native English group revealed, random attention lapses likely contributed to errors in both sub-groups. The effects of L1-L2 vowel space

overlap likely supplemented these attention lapses in the context of the non-native participants; however, these effects would not have contributed to significant results. Contributing factors were likely numerous, and attributing responsibility would prove a complex task. A look at the results in isolation, however, pointed to a more straight-forward interpretation: these relatively inexperienced, non-native participants who perceived at native-like levels suggested that a small number of adult participants could, despite many theoretical claims to the contrary, overcome language-specific, age-related limitations. Naturally, this finding will contribute to a more in-depth analysis of the age issue in section 5.4.

Complimentary to the outlying participants who perceived exceptionally better than their fellow group members, other outliers perceived exceptionally worse. As with the exceptionally good performers, the non-parametric ANOVA already accounted for individual differences and outlying data; however, a more qualitative perspective adds some insight into the data interpretation. Four participants stood out as underperformers for their discrimination scores that were significantly lower than those of Low Contact means. These participants included participant 7 (Med Contact-Austin,) who misidentified all pairs/contrasts that contained the /u/-/ʊ/ contrast and six of the pairs/contrasts that contained the /ʊ/-/u/ contrast; participant 6 of the Medium Contact (Belo) group, who misidentified eight pairs/contrasts that contained the /i/-/I/ contrast and six pairs/contrasts that contained the /u/-/ʊ/ contrast; participant 1 of the Low Contact group, who misidentified eight pairs/contrast that contained the /i/-/I/ contrast and eight pairs/contrasts that contained the /u/-/ʊ/ contrast; and participant 8, who misidentified eight pairs/contrasts that contained the /u/-/ʊ/ contrast.

These data led to speculations about the possible results if exceptional underperformers had been excluded from the between-group and within-group comparisons. Additional non-parametric ANOVAs analyzed a new data set that omitted these four participants, however, and only uncovered one significant change. This change took place within the Medium Contact (Belo) results. (Recall that, in addition to the significant values for the /u/-/ʊ/ contrast that this group shared with the Medium Contact

(Austin) and the Low Contact groups, the Medium Contact (Belo) group also found significance for the /i/-/I/ and the /ʊ/-/u/ contrasts.) The new data set found an insignificant value for the /ʊ/-/u/ vs. /e/-/ɛ/ comparison at the .084 level. This new finding affected the overall interpretations of the results in a very minimal way and reaffirmed the quantitative measure's ability to (mostly) overcome these types of distortions. As these types of performers can be expected in the context of many quantitative analyses, their relationship to the literature did not shed light on a new perspective.

Their relationship to classroom practices, however, did provide some important insight. This insight, along with that gleaned from the other two instances of individual differences will receive further mention in the following discussion that highlights implications for the English language teacher.

5.3 Implications for Foreign Language Pedagogy

This study's official findings, along with the observations noted above, provided a relatively thorough look into Brazilian Portuguese native speakers' abilities to perceive two non-native vowel contrasts in the context of various English exposure levels. Although the study's expressed quantitative approach only lends itself to generalizability within the narrow framework of the specific population and the two vowels, hopefully some of the ideas that arise from this study can also help to guide instruction of a larger variety of non-native contrasts to multiple types of classroom populations. This discussion will address the implications of the official quantitative results first and the influence of individual differences second.

The responses to the first research questions indicated that participants within the lower contact groups showed greater difficulty perceiving one non-native vowel contrast over another. This differential treatment took place, it is important to point out, in spite of nearly identical L1-L2 overlaps. In addition, participants appeared to display greater difficulty with contrasts that began with a tense vowel and ended with a lax vowel. As both tense-lax combinations were also native-non-native combinations, it was unclear which of these factors played a determining role. However, it was clear that the order of

the vowel sounds within the contrast shaped perception results. Based on these findings, language teachers should be aware that non-native sounds with equivalent mappings will likely present unequal challenges to students learning them. In addition, the sounds' order of presentation likely effect perception. Successful learning of a given sound follows exposure to the sound in various contexts. This claim's connection to theoretical support will appear in section 5.4.

Responses to the second research question also provided some helpful insight. Between-group comparisons showed significant differences between High Contact and Low Contact groups' ability to identify three of the four non-native contrasts, /I/-/i/, /u/-/ʊ/, and /ʊ/-/u/. This significant improvement through increased exposure indicates that many students are capable of acquiring new sound categories without explicit instruction. It is important to point out, however, that these new sound categories likely do not adhere to native speaker standards; they most probably fall within the confines of interlanguage. Of course, the less passive nature of exposure within the language classroom could improve these sound categories. In light of the above findings, this improvement seems even more likely.

The one non-native contrast that showed no significant difference between High Contact and Low Contact mean ranks, /i/-/I/, suggested an opposite interpretation: the /i/-/I/ contrast appears to require more explicit training to effect perceptual improvement. This finding may account for high level Portuguese native speakers' notoriously difficult distinction between 'beach' and its more vulgar, short /I/ counterpart, despite the high stakes associated with remembering the difference. This statement represents conjecture. A far less speculative statement summarizes these results' application to the foreign language classroom: exposure to a foreign language helps to enhance students' perception of some non-native sounds significantly; however, other sounds may require more active learning.

Pedagogical implications of the differential treatment of similar vowel contrasts also prove relevant in the context of the earlier discussion of individual differences. In

addition to acknowledging some contrasts' greater potential for perceptual confusion than others (despite similar L1-L2 mappings,) foreign language educators must also be aware that this differential treatment can vary depending upon the individual. In this study, for example, the /u/-/ʊ/ contrast presented greater perceptual difficulties among the lower level participants; however, a minority of students misidentified the /i/-/I/ contrast more frequently than the /u/-/ʊ/ contrast. These exceptions to the general trends will likely appear in classrooms as well; educators need to ensure that their instruction caters to these types of learners as well as those that conform more closely to the trends.

In light of the individual differences discussed in the previous section, two other types of exceptions should probably also help to inform classroom practices: these exceptions include the aforementioned underperformers and exceptional performers. Within the context of the classroom, individual students display individual perceptual abilities. Some students have the capacity to perceive target sounds without much exposure to the target language. Many more develop this perception with greater exposure, although some sounds may provide more of a challenge to them than others. Although the trends discovered in the quantitative results help to provide a broad, general look at likely perceptual patterns among students, foreign language teachers need to separate their individual students from these patterns.

On a parenthetical note, a useful incidental finding adds to these classroom suggestions. The perception test itself appeared to serve as a good perceptual training tool. All participants began the test with a clear idea about the task, which was verified through five consecutive correct answers in the training module; nevertheless, far fewer discrimination errors took place after the first quarter of the test. This observation suggested that participants learned as they progressed. As this pattern applied to all four of the non-native contrasts, this type of training tool could effectively begin to hone students' perception of a wide variety of new sounds.

5.4 Interpretations Based on the Literature

Flege and Best provided the foundation for this study's method: their theories were accepted a priory. The results of the perception test, however, both support and weaken these theoretical predictions. The first look will address the support for Flege and Best. As both would have predicted, the area(s) of significantly greater perceptual difficulty lay with the non-native contrasts that overlapped with single native vowel categories (rather than those that overlapped with a two-vowel native contrast.) Indeed, within-group results indicated that non-native participants with low and medium contact levels demonstrated significantly greater difficulty with at least the non-native /u/-/ʊ/ contrast, if not the non-native /ʊ/-/u/ and /i/-/I/ contrasts as well. Between groups, this effect was even stronger: Medium and Low Contact groups identified all four non-native contrasts, /u/-/ʊ/, /ʊ/-/u/, /i/-/I/, and /I/-/i/ with significantly less frequency than the two native vowel contrasts.

In addition to this support, however, this study's results also indicated an area of possible weakness. This weakness is in line with Bradlow *et al*. (1997) who stipulate uneven perceptual abilities among participants despite even L1-L2 mappings. Indeed, within-group results for Medium Contact (Austin) and Low Contact groups showed significance for only one out of the four non-native contrasts. Not even the within-group results for Medium Contact (Austin) participants, in which three out of four non-native contrasts received significantly lower mean ranks, adhered completely to Flege's and Best's predictions. In addition, some of the individual data (mentioned in 5.2.3) indicated instances in which certain non-native vowel combinations generated a disproportionate number of mistakes. Like the quantitative within-group results, these patterns developed despite nearly identical characterizations of the vowels' L1-L2 overlap and frequency variation. These observations cast doubt on Flege's and Best's abilities to predict all instances of L2 perception successfully.

Other studies have encountered difficulties supporting Best's theory in its entirety. Related but not directly applicable to the effects of tense-lax order in this study, Broersma and Cutler (2005) outlined their discovery of a "worst Best case." In it, they used distribution-based devoicing properties of Dutch to underline Best's simplistic

approach to perception. Among Dutch participants, they found significant perceptual differences for the same phoneme depending upon its location within a given English word. (Dutch systematically devoices its final consonants; this process changes final voiced consonants into their voiceless counterparts. English does not undergo this process.) Best would have predicted perception of the same phoneme to be uniform across various phonetic environments. In this study, too, Best's predictions could not account for changes to sounds' order of presentation.

These pair-wise order effects' incongruity with Best's model can also find support from Tversky's (1977) account of features of similarity. His study contrasted two subjects that could be labeled according to the same prototype. One of these subjects, however, was always more prototypical than the other. As in this study, he found significant effects depending upon the order of presentation. When he presented the prototype - non-prototype combination, participants often viewed them as more similar than the non-prototype – prototype variations. In this case, /i/ and /u/ were more prototypical sounds for native Brazilian speakers. Like the participants in Tversky's study, they perceived both the /u/-/ʊ/ and /i/-/I/ contrasts to be more similar than the /ʊ/-/u/ and /I/-/i/ contrasts.

In the case of the between-group data, which associated discrimination difficulties with all four of the native contrasts, results appeared to reflect Flege's and Best's theory; however, the aforementioned individual differences blur the straight-forward nature of this interpretation. These results deviated from the overall quantitative trends; thus, the between-group quantitative analysis supports Best and Flege although each of the individual cases do not. It is quite possible, therefore, that other studies with trends that support Flege's and/or Best's predictions also contain individual participant information that does not support these predictions. Such deviations from overall trends, for example, have been noted in both Bradlow *et al.* (1997) and Flege and Mackay (2004). Participants' overall adherence to the predicted trends, therefore, must not be viewed as a limitation on an individual participant's potential L2 perception.

With a mention of these exceptions, it is also necessary to reiterate the task instructions and to note their possible contribution to the individual data that deviate from Flege's and Best's theories. The instructions asked the native Brazilian participants to pretend that they were native American English speakers and to try to discriminate between the pairs/contrasts accordingly. Instead of transferring their categorical knowledge directly to non-native sounds as Flege and Best would have predicted, individuals may have employed a strategy based more on continuous perception because they knew the sounds to be foreign. This use of continuous perceptual strategies in instances of perceived foreignness receives mention in Ohala (1993). In this way, the task instructions may account for Best's and Flege's inability to predict all participants' performance; some participants may have employed different perceptual strategies than those assumed within the Flege and Best paradigms.

A second possible explanation for individuals' preference of one non-native sound over the other borrows from Simon and Fourcin (1978), who find individual differences in speakers' – even native speakers' – perception of the same acoustic information. (See chapter two for a more detailed description of their findings.) Applied to the current study's findings, these results suggest that different participants focused on different parts of the spectral information; as a result, they were disproportionately sensitive to different vowel sounds. This explanation for the observed perceptual favoritism is consistent with the data. The tendency primarily appears among participants with lower contact levels who have less (if any) categorical knowledge of American English vowel sounds.

This departure from Flege and Best makes an important statement about L2 perceptual potential. Although average non-native perceivers discriminate between given non-native vowels significantly worse than their native counterparts, some exceptional participants can actually perceive them similarly to native speakers. Associations that link Flege/Best-like general trends with upward limits on perception, therefore, are not well founded: the exceptional perceivers from the current study have not had to overcome any kind of perceptual barriers. Rather, they appear to possess exceptional individual abilities.

With the discovery of these exceptional perceivers, an additional question becomes relevant: would these participants become the exceptions to age-related perceptual effects in the context of such studies as Boengarts *et al.* (1997), Schneiderman and Desmarais (1988), Novoa *et al.* (1988), and Neufeld (1977, 1978, and 1979). The answer to this question requires further research that moves beyond trend assessments across participants.

5.5 Limitations

A thorough understanding of the current study's results, implications for foreign language pedagogy, and relationship to the literature requires a look into the study's limitations. The limitations fall under two major categories. The first category deals with the common shortcomings that apply to this type of research method in general, and thus apply to the current study as well. The second category addressed limitations that arose within the specific parameters of the current study. Within the context of the first category, weaknesses arose in the use of self-report, snowballing selection, small sample size, and limited test items. The second category contained three major areas: they dealt with English input, the exposure questionnaire, and participants' ages. The following discussion will define and clarify the limitations associated with each of these areas within the two categories.

Self-report contains inherent weaknesses relative to researcher-reported data because it relies upon the individual participant's interpretation of the information. According to Gall, Gall, and Borg (2007), self reported data raises issues of validity and reliability. As each interpretation varies according to the individual, the resulting data often does not adhere to strictly defined parameters. In the current study, the researcher attempted to overcome some of these inconsistencies by consulting with the participants. This resulted in an additional shortcoming, which will receive further mention within the more specific context of the second category.

The use of snowballing as a selection method also contributed to a bias in the study. For, all members of the target population are not potential participants. In this way, the participants may not represent the entire population accurately. In the context of this study, participants with a curiosity towards English and perception were more likely candidates. Attempts were made to include participants with negative attitudes towards English and apathy towards perception; however, these attempts were not always successful.

The final two areas in the first category can be grouped together because they affect the study's generalizability. In general, small numbers of participants and low numbers of investigated contrasts limit the contexts to which a study's interpretations apply (Hatch and Lazaraton,1991). Although the current study contained fifty total participants, some data came from comparisons between ten or twenty participants. These data would be more robust if these comparisons looked at a greater number of participants. Therefore, replication studies will be needed to help establish the reliability of the current study's results. In addition to the small number of participants, the low number of investigated contrasts also limited interpretations of the data: the use of only three contrasts tied the current study to a very specific phonological situation. Additional studies will need to investigate other contrasts before interpretations can address Brazilian Portuguese native speakers' perception of American English vowels in general.

Now, the discussion turns to the second category, which mentions limitations specific to the current study. Types of English input varied according to participants' places of residence. Austin-resident participants were exposed primarily to the specific linguistic influences that make up the Austin dialect. Belo Horizonte-resident participants, however, were exposed to a more general group of dialects, some of which included non-American and even non-native varieties. Thus, a direct comparison between the two linguistic environments is somewhat misleading. The separate analyses of Belo Horizonte and Austin Medium Contact groups attempted to accommodate for this shortcoming, and, the two types of input did not contribute to statistically different

results. Nevertheless, a study that compared two specific varieties of English input would have contributed to more generalizable results.

Despite its expressed quantitative approach, the exposure questionnaire was not entirely objective. It measured participants' monthly routines and multiplied this figure by the cumulative time. Interpreting cases in which monthly routines were not consistent across the time span required a degree of subjectivity. In addition, the questionnaire's use of self-report resulted in various interpretations across participants. The researcher tried to control for this variation by asking more specific questions and checking for agreement. In thus doing so, the researcher was basing the questionnaire on her limited knowledge of the participants' daily life. The questionnaire process lasted approximately twenty minutes, which did not provide enough time for the researcher to understand the participants' daily routines fully. The use of the three category system (high vs. medium vs. low contact) helped to overcome this limitation partially because it dealt with ranges rather than exact numbers. Nevertheless, one cannot consider this exposure questionnaire to be an entirely objective measure.

The third limitation related to participants' ages of first exposure to English. As age of acquisition has been shown to play an influential role in learners' acquisition of an L2, this is an important issue. Although the study controlled for Austin-resident Brazilian participants' age of arrival, it did not assess English exposure before this arrival period. Furthermore, the study did not consider inconsistent exposure effects that may have begun at an early age but since abated. These variations in age of first exposure may help to account for some of the individual differences.

Interpretation of this study's findings must be grounded in a solid understanding of the context from which they arose. This context incorporates the study's limitations which include both weaknesses related to the research method in general as well as those specific to the current study. With this study's findings and limitations in mind, it is now possible to view related suggestions for further research.

5.6 Follow-up Studies

On a quantitative level, more research needs to address the perception of different vowel contrasts with similar L1-L2 mappings. A look into data that explores other language comparisons would help to establish the degree to which this differential preference for specific vowels is an isolated finding or a part of a bigger pattern.

Two additional patterns emerged that still require additional clarification. First, Portuguese native speakers' significantly greater difficulty with the tense-lax combination provided a challenge for interpretation. Within the context of this study, this pair-wise order effect also represented a native-non-native order; therefore, it was not possible to test the two effects separately from one another. A follow-up study could isolate these two effects in a different language, and test them separately from one another. Second, the High Contact within-group scores showed a preference for two non-native (lax-tense) vowel combinations over a native (tense-lax) vowel combination. These participants appeared to be overcompensating for their perception of the non-native vowels: their knowledge of their non-nativeness appeared to result in a deeper focus on them. Additional research could look for these effects within the context of other groups with high levels of exposure to the target language.

As mentioned in the previous section, further research should also place greater focus on individual perceptual abilities. This appeal for further exploration into this topic echoes that of Bradlow *et al.* (1997). An appeal that relates specifically to this study would place greater attention on participants who appear to overcome projected age constraints. A qualitative approach would suit this type of study more correctly. Two types of possible studies would follow different frameworks. One type of study could stipulate attainable perception goals: instead of focusing on native-like acquisition, they would emphasize significant improvement. Another type of study could take a more longitudinal approach, which would identify lower contact level participants who possess native-like perceptual abilities and would chart their eventual progress towards attaining native-like accents.

Finally, action research could address some of these concepts within the classroom. Educators could report their own findings about general perceptual trends among various groups of students with similar language backgrounds. They could juxtapose these findings with practical insight into the role of individual differences.

Appendix A

Training Module: 1.) b/a/k vs. b/a/k 2.) p/y:/d vs. p/y:/d 3.) k/o/g vs. k/ɔ/g
4.) g/ɔ/d vs. g/ɔ/d 5.) p/y:/b vs. p/ø:/b 6.) t/at/ vs. t/a/t 7.) b/y:/k vs. b/ø:/k
8.) t/o/g vs. t/o/g 9.) b/ɔ/g vs. b/o/g 10.) t/ɔ/p vs. t/ɔ/p 11.) d/a/p vs. d/a/p
12.) k/ø:/k vs. k/ø:/k 13.) g/o/b vs. g/ɔ/b 14.) b/a/d vs. b/a/d 15.) t/y:/k vs. t/y:/k
16.) b/a/k vs. b/a/k 17.) p/y:/d vs. p/y:/d 18.) k/o/g vs. k/ɔ/g 19.) g/ɔ/d vs. g/ɔ/d
20.) p/y:/b vs. p/ø:/b 21.) t/at/ vs. t/a/t 22.) b/y:/k vs. b/ø:/k 23.) t/o/g vs. t/o/g
24.) b/ɔ/g vs. b/o/g 25.) t/ɔ/p vs. t/ɔ/p 26.) d/a/p vs. d/a/p 27.) k/ø:/k vs. k/ø:/k
28.) g/o/b vs. g/ɔ/b 29.) b/a/d vs. b/a/d 30.) t/y:/k vs. t/y:/k
(The second set of fifteen items is a repetition of the first set of fifteen items.)

1. p/ɛ/p vs. p/e/p 2. p/i/ p vs. p/I/p 3. p/e/p vs. p/ɛ/p 4. g/e/g vs. g/ɛ/g
5. p/I/p vs. p/i/p 6. p/ɛ/b vs. p/ɛ/b 7. g/u/g vs. g/ʊ/g 8. p/i/b vs. p/I/b
9. p/ɛ/b vs. p/ɛ/b 10.p/i/t vs. p/i/t 11. p/I/t vs. p/i/t 12. p/I/t vs. p/i/t
13. p/ɛ/t vs. p/e/t 14.p/u/t vs. p/u/t 15. p/ɛ/d vs. p/e/d 16. p/ʊ/d vs. p/ʊ/d
17. p/I/d vs. p/I/d 18.p/e/d vs. p/ɛ/d 19. p/e/k vs. p/ɛ/k 20. p/ʊ/k vs. p/ʊ/k
21. p/ɛ/k vs. p/ɛ/k 22.p/u/k vs. p/ʊ/k 23. p/I/k vs. p/I/k 24. p/ʊ/g vs. p/ʊ/g
25. d/i/t vs. d/I/t 26.g/ɛ/k vs.g/ɛ/k 27. g/I/d vs. g/i/d 28. g/e/b vs. g/ɛ/b
29. g/ɛ/g vs. g/ɛ/g 30.p/u/p vs. p/ʊ/p 31. p/i/g vs. p/I/g 32. p/e/g vs. p/ɛ/g
33. g/ʊ/k vs. g/u/k 34.p/u/g vs. p/ʊ/g 35. p/ɛ/g vs. p/e/g 36. b/u/p vs. b/u/p
37. b/I/p vs. b/i/p 38. b/e/p vs. b/e/p 39. b/ɛ/p vs. b/e/p 40. b/i/p vs. b/i/p
41. b/ʊ/b vs. b/u/b 42. b/u/b vs. b/ʊ/b

----------15 second Pause----------

43. b/i/b vs. b/i/b 44.b/e/b vs. b/e/b 45. b/u/b vs. b/ʊ/b 46. b/e/t vs. b/ɛ/t
47. b/u/t vs. b/u/t 48. b/ʊ/t vs. b/ʊ/t 49.b/u/t vs. b/ʊ/t 50. b/u/t vs. b/u/t
51. b/ɛ/d vs. b/ɛ/d 52. b/ʊ/d vs. b/u/d 53.b/I/d vs. b/I/d 54.b/u/d vs. b/ʊ/d
55. b/i/d vs. b/I/d 56. b/ʊ/k vs. b/ʊ/k 57. b/i/k vs. b/I/k 58. b/u/k vs. b/u/k
59.b/ʊ/k vs. b/u/k 60. b/e/g vs. b/e/g 61. b/ɛ/g vs. b/e/g 62. g/i/b vs. g/i/b
63. b/i/g vs. b/i/g 64. b/ʊ/g vs. b/ʊ/g 65. g/u/b vs. g/u/b 66. g/I/b vs. g/I/b
67. p/u/b vs. p/u/b 68. g/e/k vs. g/ɛ/k 69. g/I/t vs. g/I/t 70. g/ɛ/t vs. g/ɛ/t
71. t/e/p vs. t/e/p 72. t/ɛ/p vs. t/ɛ/p 73. t/ʊ/p vs. t/u/p 74. t/e/p vs. t/ɛ/p
75. t/I/b vs. t/i/b 76. t/ɛ/b vs. t/e/b 77. t/ɛ/b vs. t/ɛ/b 78. t/ʊ/b vs. t/u/b
79.t/I/b vs. t/i/b 80. t/i/t vs. t/i/t 81. t/I/t vs. t/i/t 82. t/I/t vs. t/I/t
83. t/I/t vs. t/i/t 84. t/ʊ/t vs. t/u/t

----------15 second Pause----------

85. t/I/d vs. t/i/d 86. t/i/d vs. t/I/d 87. t/ʊ/d vs. t/u/d 88. t/I/d vs. t/i/d
89. t/u/d vs. t/ʊ/d 90. t/ʊ/k vs. t/ʊ/k 91. t/e/k vs. t/e/k 92. t/ɛ/k vs. t/ɛ/k
93. t/ɛ/k vs. t/e/k 94. t/i/k vs. t/I/k 95. t/u/g vs. t/u/g 96. t/I/g vs. t/I/g
97. t/e/g vs. t/e/g 98. t/u/g vs. t/u/g 99. t/i/g vs. t/I/g 100. t/ʊ/g vs. t/ʊ/g
101.g/i/k vs. g/i/k 102.b/u/g vs. b/u/g 103.g/e/d vs. g/ɛ/d 104.g/i/t vs. g/i/t
105.g/ɛ/p vs. g/ɛ/p 106.d/I/p vs. d/I/p 107.d/e/p vs. d/ɛ/p 108.d/e/p vs.d/e/p
109.d/u/p vs. d/ʊ/p 110.d/I/b vs. d/I/b 111.d/ʊ/b vs. d/u/b 112.d/u/b vs. d/ʊ/b
113.d/I/b vs. d/i/b 114.d/I/t vs. d/I/t 115.d/ʊ/t vs. d/ʊ/t 116.d/ɛ/t vs. d/e/t
117.g/i/k vs. g/I/k 118.d/e/t vs. d/e/t 119.d/i/d vs. d/i/d 120.d/I/d vs. d/i/d
121.d/I/d vs. d/I/d 122.d/e/d vs. d/ɛ/d 123.d/e/d vs. d/ɛ/d 124.d/u/k vs. d/u/k
125.d/u/k vs.d/ʊ/k 126.d/ɛ/k vs. d/ɛ/k

----------15 second Pause----------

127.d/e/k vs. d/e/k 128. d/u/k vs. d/ʊ/k 129.d/u/g vs. d/ʊ/g 130.d/e/g vs. d/ɛ/g
131.d/u/g vs. d/u/g 132.d/ʊ/g vs. d/u/g 133.d/ɛ/g vs. d/e/g 134.d/ʊ/g vs. d/ʊ/g
135. g/e/g vs. g/e/g 136. g/I/d vs. g/I/d 137. g/i/d vs. g/i/d 138. g/ʊ/t vs. g/ʊ/t
139. p/u/g vs. p/u/g 140. g/ɛ/t vs. g/e/t 141.k/i/p vs. k/i/p 142.k/I/p vs. k/i/p
143.k/e/p vs. k/e/p 144.k/ɛ/p vs. k/e/p 145.k/u/p vs. k/ʊ/p 146.k/e/b vs. k/ɛ/b
147.k/I/b vs. k/i/b 148.k/i/b vs. k/i/b 149.k/e/b vs. k/e/b 150.k/i/b vs. k/I/b
151.k/e/t vs. k/ɛ/t 152.k/u/t vs. k/u/t 153.k/ʊ/t vs. k/u/t 154.k/ʊ/t vs. k/ʊ/t
155.k/e/d vs. k/ɛ/d 156.k/u/d vs. k/ʊ/d 157.k/i/d vs. k/i/d 158.k/ʊ/d vs. k/u/d
159.k/i/d vs. k/I/d 160.k/ɛ/k vs. k/e/k 161.k/i/k vs. k/I/k 162.k/ʊ/k vs. k/ʊ/k
163.k/ʊ/k vs. k/u/k 164.k/ʊ/k vs. k/ʊ/k 165.k/e/g vs. k/e/g 166.k/ɛ/g vs. k/e/g
167.k/ɛ/g vs. k/ɛ/g 168.k/i/g vs. k/i/g

= Identical sounds for /i/ total: 14 (7 with voiced codas, 7 with voiceless codas)

= Identical sounds for /I/ total: 14 (7 with voiced codas, 7 with voiceless codas)

= Identical sounds for /e/ total: 14 (7 with voiced codas, 7 with voiceless codas)

= Identical sounds for /ɛ/ total: 14 (7 with voiced codas, 7 with voiceless codas)

= Identical sounds for /u/ total: 14 (7 with voiced codas, 7 with voiceless codas)

= Identical sounds for /ʊ/ total: 14 (7 with voiced codas, 7 with voiceless codas)

= Contrasting sounds /e/ and /ɛ/ total: 28

- /e/ vs. /ɛ/ contrast: 14 (7 with voiced codas, 7 with voiceless codas)
- /ɛ/ vs. /e/ contrast: 14 (7 with voiced codas, 7 with voiceless codas)

= Contrasting sounds /I/ and. /i/ total: 28

- /i/ vs. /I/ contrast: 14 (7 with voiced codas, 7 with voiceless codas)
- /I/ vs. /i/ contrast: 14 (7 with voiced codas, 7 with voiceless codas)

= Contrasting sounds for /u/ and /ʊ/ total: 28

- /u/ vs. /ʊ/ contrast: 14 (7 with voiced codas, 7 with voiceless codas)
- /ʊ/ vs. /u/ contrast: 14 (7 with voiced codas, 7 with voiceless codas)

___ = Vowel is followed by a voiced coda

Appendix B

Part A: General Questions:

1. Have you ever taken English classes? If so, please describe where you took classes and for how long.

2. Have you ever studied music or voice? For how long?

3. Have you ever studied or do you speak any other foreign languages?

4. Have you ever lived with a native speaker of English? If so, for how long? In what ways do/did you interact?

5. What is your job? How long have you had this job? How much English do you hear at work everyday?

6. (For participants who live in the United States) How long have you lived in the United States?

Part B: Specific Questions: Questionnaire to Assess Levels of Exposure

The following questions help us to know how much English you come into contact with in your daily life. Please keep this purpose in mind while you answer the following questions. If you have any questions, ask Anne at any time.

1. Before evaluating your amount of English contact, I would first like to know about some of your habits. How much time do you spend in the following situations during a typical week? Please check the appropriate box. For example, if you spend 30% of a typical week at work, please check the 30% box. It is also OK to have some overlap (for example, if you listen to music, radio, or t.v. 10% of your week *at home with other people* and listen to the radio 20% of your week *at work*, your total for *listening to music, radio, or television* would be 30%.)

	0 %	0-5%	5-10%	10-15%	15-20%	20-25%	25-30%	30-35%	35-40%	40%+ please specify
At home with other people										
Listening to music, radio, or television										
Visiting family members at their house										
In public places (parks, bus stops, etc.)										
In commercial places (stores, bars, etc)										
At work (including volunteer work)										
Visiting friends at their house										
On the telephone										
While on vacation										
At Parties/social gatherings										
At church or church functions										
Other (specify:) _____ ___										

2. Think about the period of time you have lived in Austin. (If this period is greater than five years, then just focus on the past five years.) Of all of the time you spend in each situation, how often do you typically hear English in the following situations? Please estimate to the nearest 10%. If you gave 0% for a given category in the previous classification, just leave the row blank. (Note: 100% = 100% of the time that you are in the given situation - not 100% of the week.)

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
With people at home											
While listening to music, radio, or television											
While visiting family members											
In public places (parks, bus stops, etc.)											
In Commercial places (stores, restaurants, etc.)											
At work (including volunteer work)											
While visiting friends											
On the telephone											
While on vacation											
At Parties/social gatherings											
At church or church functions											
Other (please specify): _____											

3. Think about the last month. Of all of the time you spend in each situation, how often do you typically understand English in the following situations? Please estimate to the nearest 10%. Continue to leave rows blank if they received 0% in the first classification.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
With people at home											
While listening to music, radio, or television											
While visiting family members											
In public places (parks, bus stops, etc.)											
At work (including volunteer work)											
While visiting friends											
On the telephone											
While on vacation											
At Parties / social gatherings											
At church or church functions											
Other (Please specify): _____ _____											

4. Think about the last month. Of all of the time you spend in each situation, how often do you typically speak English in the following situations? Please estimate to the nearest 10%. Continue to leave rows blank if they received 0% in the first classification.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
With people at home											
While listening to music, radio, or television											
While visiting family members											
In public places (parks, bus stops, etc.)											
In Commercial places (stores, restaurants, etc.)											
At work (including volunteer work)											
While visiting friends											
On the telephone											
While on vacation											
At Parties/social gatherings											
At church or church functions											
Other: _____ ____											

5. Who typically speaks English to you & what is their relationship to you?

	First name or initials:	Relationship to you:
1		
2		
3		
4		
5		
6		
7		

6. Who <u>sometimes</u> speaks English to you & what is their relationship to you?

	First name or initials:	Relationship to you:
1		
2		
3		
4		
5		
6		
7		

7. How well do you speak, understand, read, and write English and Portuguese. Use the number "1" if your ability is poor, "7" if your ability is good, and numbers in between for ability levels that are in between.

	English								Portuguese						
	1	2	3	4	5	6	7		1	2	3	4	5	6	7
understanding															
speaking															
reading															
writing															

Thank you very much for your participation. Anne will contact you soon to make an appointment for the vowel perception test.

Appendix C

Questionário para Avaliar Níveis do Contato com Inglês

As seguintes perguntas ajudam-me saber com o quanto de inglês você tem contato no seu dia-a-dia. Favor lembrar disso enquanto estiver respondendo às perguntas. Caso você tenha alguma dúvida, pergunte à Anne a qualquer momento.

1. Antes de avaliar a quantidade de inglês que você encontra na sua rotina, gostaria, primeiramente, de saber um pouco sobre seus hábitos. Indique quanto tempo você gasta nas situações seguintes durante uma semana típica. (Pense somente no tempo que está acordado.) Favor colocar um [x] na caixa apropriada. Por exemplo, se você fica 30% de uma semana típica no trabalho, coloque um [x] na caixa de 30%. Não tem problema se tiver alguma sobreposição. (Por exemplo, se você escuta a música, o rádio, ou a televisão 10% da semana quando está *em casa com outras pessoas* e 20% da semana quando está *no trabalho*, seu total para a categoria, *escutando música, rádio ou televisão* é 30% mesmo se acontece em lugares indicados por outras categorias.)

	0 %	0-5%	5-10%	10-15%	15-20%	20-25%	25-30%	30-35%	35-40%	40%+ favor anotar
Em casa com outras pessoas										
Escutando música, rádio ou televisão em inglês (em qualquer lugar)										
Em visitas em casas de parentes										
Em lugares públicos (parques, pontos de ônibus, etc.)										
Em lugares comerciais(lojas, barzinhos, etc)										
No trabalho (inclusive trabalho voluntário)										
Em visitas em casas de amigos										
Ao telephone										
Nas férias										
Nas festas/reuniões sociais										

	0 %	0-5%	5-10%	10-15%	15-20%	20-25%	25-30%	30-35%	35-40%	>40% (anote)
Na igreja/eventos da igreja										
Outra situação (anote abaixo): _____										

2. Pense no seu dia-a-dia. De todo o tempo que você fica em cada situação indicada, que porcentagem deste tempo você ouve inglês? Favor colocar um [x] no 10% mais perto. Se a categoria já era 0% na clasificação anterior, não tem que preencher. Note que 100% = 100% do tempo que você está na situação dada – não 100% da semana.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Em casa com outras pessoas											
Ouvindo música, radio ou televisão											
Em visitas em casas de parentes											
Em lugares públicos (parques, pontos de ônibus, etc.)											
Em lugares comercias (lojas, barzinhos, etc.)											
Com pessoas no trabalho (inclusive trabalho voluntário)											
Em visitas em casas de amigos											
Ao telephone											
Nas férias											
Nas festas/reuniões sociais											
Na igreja/eventos da igreja											
Outra situação (anote abaixo): _____											

3. Pense no último mês. De todo o tempo que você fica em cada situação indicada, que porcentagem deste tempo você compreende inglês? Favor colocar um [x] no 10% mais perto (se a categoria já era 0%, não tem que preencher).

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Em casa com outras pessoas											
Escutando música, rádio ou televisão em inglês											
Em visitas em casa de parentes											
Em lugares públicos (parques, pontos de ônibus, etc.)											
Em lugares comercias (lojas, barzinhos, etc.)											
No trabalho (inclusive trabalho voluntário)											
Em visitas em casas de amigos											
Ao telephone											
Nas férias											
Nas festas/reuniões sociais											
Na igreja/eventos da igreja											
Outra situação (anote abaixo): _____											

4. Pense no último mês. De todo o tempo que você fica em cada situação indicada, que porcentagem deste tempo você fala inglês? Favor colocar um [x] na porcentagem que
mais se aproxima da sua resposta (se a categoria já era 0%, não preencha).

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Em casa com outras pessoas											
Em visitas em casas de parentes											

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Em lugares comercias (lojas, barzinhos, etc.)											
No trabalho (inclusive trabalho voluntário)											
Em visitas em casas de amigos											
Ao telefone											
Nas férias											
Nas festas/reuniões sociais											
Na igreja/eventos da igreja											
Outra situação (anote abaixo): _____											

5. Quem fala inglês com você <u>normalmente</u> e qual é a relação dessa pessoa com você?

	Primeiro nome ou inicias:	Relação com você
1.		
2.		
3.		
4.		
5.		
6.		
7.		

6. Quem fala inglês com você <u>às vezes</u> e qual é a relação dessa pessoa com você?

	Primeiro nome o inicias:	Relação a você
1.		
2.		
3.		
4.		
5.		
6.		
7.		

7. Como é sua habilidade de compreender, falar, ler e escrever português e inglês? Coloque um [x] no "1" se sua habilidade for pobre, coloque um [x] no número "7" se for boa, e coloque um [x] no espaço de um dos números do meio se for entre pobre e boa.

	Inglês								Português						
	1	2	3	4	5	6	7		1	2	3	4	5	6	7
Compreensão															
Fala															
Escrita															
Leitura															

Muito obrigada pela sua participação. A Anne vai entrar em contato em breve para combinar um horário para a realização do teste de percepção.

Appendix D: Raw Scores

Participant	/ɛ/-/ɛ/	/ɛ/-/e/	/e/-/ɛ/	/e/-/e/	/ɪ/-/ɪ/	/ɪ/-/i/	/i/-/ɪ/	/i/-/i/	/ɔ/-/ɔ/	/ɔ/-/u/	/u/-/ɔ/	/u/-/u/
NES #1	100	100	100	100	100	100	100	100	100	100	100	92.86
NES #2	100	92.86	92.86	100	100	100	100	100	100	92.86	100	100
NES #3	100	100	100	100	100	100	100	100	100	100	92.86	100
NES #4	100	100	100	100	100	100	100	100	100	100	100	100
NES #5	100	100	100	100	100	100	100	100	100	100	92.86	100
NES #6	100	92.86	92.86	92.86	100	100	100	100	100	100	92.86	100
NES #7	100	100	92.86	100	100	100	100	100	100	100	100	100
NES #8	100	100	100	92.86	100	100	100	92.86	92.86	100	100	92.86
NES #9	100	100	100	100	100	100	100	100	100	100	100	100
NES #10	100	100	100	100	100	100	100	100	100	100	100	100
High #1	85.71	100	92.86	92.86	100	100	100	100	92.86	100	100	100
High #2	100	100	100	92.86	100	100	100	100	100	100	92.86	100
High #3	100	100	92.86	100	100	100	92.86	100	100	100	100	100
High #4	100	92.86	85.71	100	100	100	92.86	100	85.71	100	100	100
High #5	100	100	92.86	100	100	100	92.86	100	92.86	100	100	100
High #6	92.86	100	85.71	100	100	100	92.86	100	85.71	100	78.57	92.86
High #7	100	100	100	100	100	100	92.86	100	71.43	100	92.86	100
High #8	100	92.86	92.86	92.86	100	100	92.86	100	100	100	100	100
High #9	100	92.86	100	92.86	100	100	100	100	92.86	100	100	92.86
High #10	100	100	85.71	100	100	100	100	100	100	100	92.86	100
Med (Aus) #1	100	100	85.71	100	100	100	78.57	92.86	100	100	92.86	100
Med (Aus) #2	100	100	92.86	100	100	71.43	100	100	100	100	92.86	100
Med (Aus) #3	100	100	100	100	92.86	92.86	85.71	100	100	100	85.71	100
Med (Aus) #4	100	92.86	92.86	100	100	100	100	100	100	78.57	71.43	100
Med (Aus) #5	100	92.86	100	100	85.71	100	85.71	100	100	100	85.71	100
Med (Aus) #6	100	85.71	92.86	100	92.86	100	100	100	100	92.86	71.43	100
Med (Aus) #7	100	100	92.86	100	100	100	92.86	100	100	57.14	0	92.86
Med (Aus) #8	100	92.86	100	100	78.57	92.86	71.43	100	100	100	71.43	92.86
Med (Aus) #9	100	100	100	100	100	100	92.86	100	100	100	92.86	92.86
Med (Aus) #10	100	92.86	100	92.86	92.86	100	92.86	100	92.86	85.71	92.86	100
Med (Belo) #1	100	100	100	100	100	100	92.86	100	100	92.86	57.14	100
Med (Belo) #2	78.57	100	100	92.86	71.43	100	100	85.71	92.86	92.86	100	92.86
Med (Belo) #3	78.57	92.86	92.86	78.57	64.29	85.71	92.86	100	92.86	85.71	78.57	92.86
Med (Belo) #4	78.57	92.86	92.86	78.57	78.57	100	85.71	78.57	85.71	92.86	78.57	92.86
Med (Belo) #5	100	100	100	100	100	100	92.86	100	100	100	85.71	100
Med (Belo) #6	100	100	100	100	100	85.71	42.86	100	100	57.14	100	100
Med (Belo) #7	100	92.86	100	92.86	100	100	92.86	100	92.86	100	100	92.86
Med (Belo) #8	100	100	100	100	100	100	78.57	100	100	92.86	57.14	100
Med (Belo) #9	100	100	92.86	100	100	92.86	100	92.86	100	100	100	92.86
Med (Belo) #10	92.86	85.71	100	85.71	78.51	71.43	78.51	100	78.51	85.71	64.29	85.71
Low #1	100	100	78.57	100	92.86	92.86	42.86	92.86	92.86	85.71	42.86	100
Low #2	100	100	78.57	100	100	85.71	71.43	100	100	85.71	64.29	100
Low #3	100	100	100	100	100	92.86	92.86	85.71	100	78.57	71.43	100
Low #4	100	100	92.86	100	92.86	78.57	92.86	100	100	71.43	64.29	100
Low #5	100	78.57	85.71	92.86	100	92.86	92.86	92.86	100	78.57	71.43	100
Low #6	71.43	92.86	100	100	85.71	92.86	100	100	85.71	92.86	71.43	100
Low #7	92.86	100	100	92.86	92.86	100	92.86	85.71	100	100	100	92.86
Low #8	100	85.71	71.43	100	100	78.57	71.43	100	100	92.86	42.86	100
Low #9	100	100	100	92.86	100	92.86	100	92.86	100	100	100	100
Low #10	92.86	92.86	92.86	92.86	100	78.57	78.57	100	85.71	100	78.57	85.71

Appendix E:
Uncontrolled Variables

Key:

attitude:
0 = neutral
1 = negative
2 = positive

gender:
1 = male
2 = female

age:
1 = 20-24
2 = 24-29
3 = 30-34
4 = 35-39

participant	Attitude	Gender	Age
NES #1		2	2
NES #2		2	2
NES #3		2	2
NES #4		1	3
NES #5		2	3
NES #6		1	2
NES #7		2	3
NES #8		1	4
NES #9		1	4
NES #10		1	2
High #1	2	2	4
High #2	2	2	3
High #3	0	2	3
High #4	0	2	1
High #5	2	1	2
High #6	1	2	3
High #7	0	1	3
High #8	2	1	1
High #9	2	1	2
High #10	0	1	4
Med (Aus) #1	2	2	2
Med (Aus) #2	2	2	2
Med (Aus) #3	0	2	1
Med (Aus) #4	2	1	2
Med (Aus) #5	2	1	2
Med (Aus) #6	0	2	3
Med (Aus) #7	1	1	4
Med (Aus) #8	0	1	4
Med (Aus) #9	2	1	1
Med (Aus) #10	0	2	4
Med (Belo) #1	2	2	3
Med (Belo) #2	0	1	2
Med (Belo) #3	1	1	2
Med (Belo) #4	2	1	4
Med (Belo) #5	2	2	4
Med (Belo) #6	2	1	3
Med (Belo) #7	2	2	1
Med (Belo) #8	2	2	2
Med (Belo) #9	2	2	2
Med (Belo) #10	2	1	2
Low #1	1	1	3
Low #2	1	2	4
Low #3	1	2	3
Low #4	0	1	4
Low #5	2	2	2
Low #6	0	1	3
Low #7	2	1	3
Low #8	2	1	2
Low #9	0	1	1
Low #10	2	1	2

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